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BERGEN'S
GUIDE BOOK
TO THE
LOCAL MARINE BOARD
EXAMINATION.

4/-





BERGEN'S GUIDE BOOK

TO THE

LOCAL MARINE BOARD EXAMINATIONS

CONTAINING THE

NEW QUESTIONS

REQUIRED BY

THE BOARD OF TRADE,

ON AND AFTER THE 1st OF AUGUST, 1881.

BY

WILLIAM CULLEY BERGEN,

MASTER IN THE MERCANTILE MARINE,
AUTHOR OF BERGEN'S "MARINE ENGINEER," BERGEN'S
"SEAMANSHIP," ETC.

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PREFACE.

The following work is adapted to the requirements of the Board of Trade after the 1st of August, 1881; a few Tables required for the solution of the questions are given, so that those persons who use Bergen's Navigation will not need any other work

The author is indebted to Capt. Wm. B. Duncan, Teacher of Navigation, South Shields, for his valuable help and useful suggestions, while the work was passing through the press.

WM. C. BERGEN.

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HINTS TO CANDIDATES.

1. Before presenting themselves at the Examination Rooms, candidates should see that their applications are properly filled up, and that their papers and testimonials are in regular order ; any mistake or omission in regard to these will cause delay and disappointment.

(a) *Second Mates* should, show on their applications the whole of their service since they first went to sea.

(b) *Only Mates, First Mates and Masters* should show on their applications the whole of their service since the date of their last certificate.

(c) *All Grades* must show 12 months service in a square rigged vessel, as seaman, mate, or master ; otherwise they can only obtain certificates for steamers.

(d) *All Grades* must produce good testimonials for their last 12 months service, from the date of the examination.

(e) The time upon the application must be in *consecutive order*. All service, whether as Apprentice, Boy, O.S., A.B., Cook, Steward or Carpenter, must be shewn ; and if a candidate has been on shore for more than two months at a time, he must state on his application what he has been doing during the interval.

2. *Second Mates' service in the coasting trade does not count to entitle them to pass as First Mate or Master ; but such service must appear upon the applications.*

8. Pens and ink are provided in the Board Room, and Candidates must not on any account take books or papers of any kind into the Board Room, except their applications, testimonials, and discharges. This rule does not apply to penholders or pens.



No communication between Candidates is allowed, and a Candidate infringing this rule, or assisting any other will be instantly dismissed, and will lose the fee he has paid.

4. Candidates are recommended to be calm and steady, and not to begin to work until they have attended to the following rules.

(a) As soon as you receive your examination paper from the examiner copy your rotation number into the examination paper, and write the name of the port, day of the month, and the year, in their appropriate places ; also write your name close to the foot of the page on both sides of every sheet you receive ; be specially careful to do this.

5. Keep your work well up towards the top of the page, close and compact, and do not spread it all over the sheet ; otherwise if you make any errors you will not have room to commence the work afresh ; write the names of the latitude in, longitude in, declination, &c., and the answers to the questions clearly and neatly.

If your paper is returned to you for correction, do not leave any of the incorrect work standing on the paper, but draw your pen across it and cancel it.

Keep the minor corrections abreast of the work they belong to.

6. You are not allowed to leave the premises during the examination, but you may go to the retiring room if you give up the paper on which you are engaged, and ask leave to do so.

WM. C. BERGEN.

EXAMINATION IN CHART.

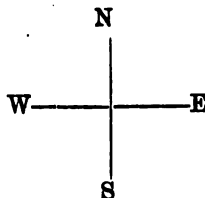
EXAMPLE I.

(1.) Using Deviation Card No.....find the course to steer by compass from Bolt Tail to the West end of Guernsey Island. By Magnetic Chart, variation 24°W .

Mag. Course S by E $\frac{1}{2}$ E = $S21^{\circ}\text{E}$
Deviation 3W to right

Compass Course S $\frac{1}{2}$ E = $S18^{\circ}\text{E}$

Distance 67 miles.



(2.) With the ship's head on the above-named compass course Bolt Head bore $N\frac{1}{2}\text{W}$, and the Start bore NE by E $\frac{1}{2}$ E, by the same compass; find the ship's position.

	Bolt Head.	Start.
Compass Bearings	$N\frac{1}{2}\text{W} = N6^{\circ}\text{W}$	$\text{NE by E } \frac{1}{2} \text{ E} = N62^{\circ}\text{E}$
Dev. same as in (1)	3W to left	8W

Mag. Bearing	$N\frac{1}{2}\text{W} = N9^{\circ}\text{W}$	$\text{NE by E } \frac{1}{2} \text{ E} = N59^{\circ}\text{E}$
--------------	---	---

Answer.—Latitude $50^{\circ} 9'\text{N}$. Longitude $8^{\circ} 41'\text{W}$

(8.) With the ship's head as above the Start bore by compass NE by E, and after continuing on the same course 18 miles it bore North; find the position of the ship and her distance from the Start.

Compass Bearings	NE by E = $N56^{\circ}\text{E}$	and N 0°W
Dev. same as in (1)	8W to left	8W

Mag. Bearings	NE $\frac{1}{2}$ E = $N58^{\circ}\text{E}$	N $\frac{1}{2}$ W = $N8^{\circ}\text{W}$
---------------	--	--

Answer.—Latitude $49^{\circ} 54'\text{N}$. Longitude $8^{\circ} 28'\text{W}$. Dist. from Start, 21 miles.

ADDITIONAL FOR MASTER.

(4.) Find the course to steer by compass from Bolt Tail to the West end of Guernsey Island (see Question 1) to counteract the effect of a current which set W by N magnetic, 8 miles per hour, the ship making by log 10 miles per hour; also the distance the ship would then make good per hour towards Guernsey.

Remarks.—As the scale of the Chart is too small to make the figure for this problem distinct, take 5 miles on the longitude scale to represent 1 mile in this question, then by drawing the figure 3 miles W by N from A to B. and then 10 miles from B to C, we have as follows:—

Mag. Course from B to C SE $\frac{1}{2}$ S = $S35^{\circ}\text{E}$
Deviation 4E to left

Compass Course SE $\frac{1}{2}$ S = $S39^{\circ}\text{E}$

Answer.—Distance from A to C 8 miles nearly = distance made good per hour.

To find Deviation.

Ship's head.	Dev.	° E
SE	9°E	3
SE by S	3°E	+1
	6	4
	60	—
	8)360	
	45	

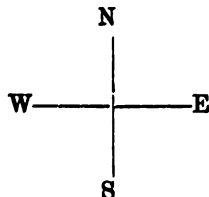
EXAMINATION IN CHART.

EXAMPLE II.

(1.) Using Deviation Card No. 1... find the course to steer by compass from the East Point of Guernsey to Berry Head, by Magnetic Chart.

Mag. Course N by W = $N11^{\circ}W$
 Deviation $4W$ to right.

Ans.—Compass Course $N\frac{1}{2}W = N7W$
 Distance 65 miles.



(2.) With the ship's head on the above-named compass course, the West Point of Guernsey bore $SSW\frac{1}{2}W$ and the Casquets bore E by S by the same compass; find the ship's position.

	West Point.		Casquets.
Compass Bearings	$SSW\frac{1}{2}W = 828^{\circ}W$	and	E by S = $879^{\circ}E$
Dev. same as in (1)	$4W$ to left.		$4W$

Mag. Bearing	$SSW\frac{1}{2}W = 824W$		$E\frac{1}{2}S = 888E$
--------------	--------------------------	--	------------------------

Answer.—Lat. $49^{\circ}41'N$. Long. $2^{\circ}41'W$

(3.) With the ship's head as above the Casquets bore by compass ENE, and after continuing on the same course for 12 miles it bore SE by E; find the position of the ship, and her distance from the Casquets at the time of taking the second bearing.

	Casquets.
Compass Bearings	ENE = $N68^{\circ}E$ and SE by E = $856^{\circ}E$
Dev. same as in (1)	$4W$ to left $4W$

Mag. Bearings	NE by E $\frac{1}{2}E = N64E$		SE by E $\frac{1}{2}E = 860E$
---------------	-------------------------------	--	-------------------------------

Answer.—Lat. $49^{\circ}45'N$. Long. $2^{\circ}45'W$. Casquets distant 14 miles.

ADDITIONAL FOR MASTER.

(4.) Find the course to steer by compass from Guernsey to Berry Head (see Question 1) to counteract the effect of a current which set E by S magnetic, $2\frac{1}{2}$ miles per hour, the ship making by log 9 miles per hour; also the distance the ship would then make good per hour towards Berry Head.

Mag. Course from B to C $NNW\frac{1}{2}W = N27^{\circ}W$
 Deviation ... $10W$ to right.

Compass Course N by W $\frac{1}{2}W = N17W$

Distance from A to C $7\frac{1}{2}$ miles nearly = distance made good per hour towards Berry Head.	}	Answer.

Consecutive Office No. 178.
Departmental 895.
Examinations 11.

BOARD OF TRADE,
Marine Department,
January, 1881.

EXAMINATION
FOR
CERTIFICATES OF COMPETENCY
OF
MASTERS AND MATES OF FOREIGN-GOING STEAMSHIPS.

Preliminary.

On and after the 1st day of March, 1881, certificates of competency will be issued subject to the examinations herein-after described, for officers who have served in steamships, and who, owing to absence of service in square rigged sailing ships, cannot under the existing regulations obtain certificates of competency to act in the capacity of masters or mates of square rigged steamships.

These certificates will entitle the holders to go to sea as masters and mates of foreign-going steamships, but will not entitle the holders to go to sea as masters or mates of foreign-going sailing ships.

The forms of certificates will differ from those at present in use.

There will be no distinction in respect of "fore and aft," and "square-rigged" steamships.

Regulations as to Examinations.

**QUALIFICATIONS FOR CERTIFICATES OF COMPETENCY FOR FOREIGN-GOING
STEAMSHIPS ONLY.**

Examination in Colours.—All candidates for certificates of competency must pass the Examination in colours.

A Second Mate.—Must be 17 years of age, and must have been four years at sea.

In Navigation.—He must write a legible hand, and will be required to give in writing definitions of various astronomical and other terms used in navigation. He must have a competent knowledge of the first five rules of arithmetic and the use of logarithms. He must be able to work a day's work complete, correcting the

courses for deviation, leeway, and variation. He will be required to find the latitude by meridian altitude of the sun, and the difference of longitude from a given departure by parallel sailing ; also to find the course and distance from one position to another by Mercator's method. He will be required to find the time of high water at a given port, to observe and calculate the amplitude of the sun, and to find the error of the ship's compass therefrom, and also the deviation, the variation being given. He must be able to find the daily rate of the chronometer from error observed, and to find the longitude from altitude of the sun by the usual methods. He must understand the use of the sextant with its adjustments, and be able to observe with it, find the index error by the horizon, and read off and on the arc. He must also pass a satisfactory examination in the International Code of Signals.

In Seamanship.—He must give satisfactory answers as to the standing and running rigging of steamships ; as to bending, unbending, setting, reefing, taking in and furling sail ; as to sending masts and yards up and down, &c., &c. ; as to seeing everything in readiness and clear for getting under way, and as to the precautions to be then observed with regard to engines, propeller, &c., ; as to the management of a steamship when under canvas ; and as to dunnaging and stowing cargo, &c. He must have a thorough knowledge of the rule of the road as regards both steamers and sailing vessels, their regulation lights, and fog, and sound signals, and be able to describe the signals of distress and the signals to be made by ships wanting a pilot, and the liabilities and penalties incurred by the misuse of these signals. He must be able to mark and use the lead and log lines. He must also understand the construction, use, and action of the sluices, and of the water-ballast tanks, engine room telegraph, &c. ; the use and management of the rocket apparatus in the event of his vessel being stranded, and other questions of a like nature, appertaining to the duties of the second mate of a steamship, which the examiner may think necessary to put to him.

An Only or First Mate.—An only mate must be 19 years of age, and must have served five years at sea. A first mate must be 19 years of age and must have served five years at sea, of which one year must have been as second or only mate of a foreign going steamship.

In Navigation.—In addition to the qualifications required for a second mate, an only, or first mate must be able to find the true bearing of the sun and the error of the ship's compass from an observed azimuth of the sun, both from an altitude and also from the "Time Azimuth Tables," and with the variations given compute the deviation ; to find the latitude from a single altitude of the sun off the meridian, and to be able to use and adjust the sextant, and to find the index error by the sun, and also to ascertain the true bearing of the sun and the ship's position by Sumner's method by projection. He must also be conversant with the use of Mercator's chart and be able to find, on either a *true* or *Magnetic* chart, the course to steer and the distance from one given position to another ; and find the ship's position on the chart from cross bearings of two objects ; from two bearings of the same object, the course and distance between the bearings being given ; and also the distance of ship from the object at the time of taking the second bearings.

In Seamanship.—In addition to the qualifications required for a second mate, a more extensive knowledge of seamanship will be required, as to shifting large spars, rigging sheers, taking lower masts in and out, how to moor and unmoor ship and to keep a clear anchor, to carry out an anchor ; how to manage a steamship in stormy weather, and how to rig purchases for getting heavy weights, anchors, machinery, &c., in and out. He must give satisfactory answers as to the ventila-

tion of holds, and the stowage of explosives. He must be able to describe the effects of the screw race upon the rudder; and the effect produced on the direction of the head of the ship by going (ahead) (astern) with a (right) (left) handed screw when the rudder is (ported) (starboarded). He must also know how to rig a sea anchor, and what means to apply to keep a steamer with machinery disabled out of the trough of the sea, and lessen her lee drift. How to turn a steamship short round; how to get cast of deep sea lead in heavy weather, and other questions of a like nature appertaining to the duties of the first mate of a steamship, which the examiner may think necessary to put to him.

A Master.—Must be 21 years of age, and have been six years at sea, of which one year must have been as first mate in a foreign going steamship, and one year as second or only mate; or he must have been six and a half years at sea, of which two and a half years must have been as second or only mate, during the last 12 months of which he must have been in possession of a first mate's certificate.

In Navigation.—In addition to the qualifications required for a second and first mate, he must be able to compute the latitude from the meridian altitude of a star, &c.; he must be able to find the magnetic bearing from equidistant compass bearings of any fixed object when at sea, and compute the deviation therefrom, He must construct a deviation curve upon a "Napier's" diagram which will be furnished by the examiner, and understand the practical application of the same, and give written answers to certain practical questions on the effect of the ship's iron upon the compasses, the method of determining the deviation, and compensating same by magnets and soft iron. He will be required to find the course to steer by compass in order to counteract the effect of a given current, and find the distance the ship will make good towards a given point in a certain time, and to work out practically the correction to apply to soundings taken at a given time and place, to compare with the depth marked on the chart.

In Seamanship.—In addition to the qualifications required of a second and first mate, he must be able to construct rafts and jury rudders suitable for a screw steamship. He will be examined as to his resources for the preservation of the ship's crew in the event of wreck; as to the management of steamships in heavy weather; as to rescuing the crew of a disabled ship; as to steps to be taken when a ship is on her beam ends; or if disabled and on a lee shore. How to use steam appliances in the event of fire, and the best arrangement for towing vessels under different circumstances, placing ship in dry dock, directing repairs, and the mode of procedure if putting into port in distress with damage to cargo and ship. He must possess a sufficient knowledge of what he is required to do by law, as to entry and discharge, and the management of his crew, and as to penalties, and entries to be made in the official log, and a knowledge of the measures for preventing and checking the outbreak of scurvy on board ship, and the law as to load line marks, the entries and reports to be made respecting them. He will be questioned as to his knowledge of invoices, charter party, bills of lading, Lloyd's agent, and as to the nature of bottomry, also bills of exchange, surveys, averages, &c, and such other operations and duties of a like nature, appertaining to the management of a steamship, as the examiner may consider it necessary to touch upon.

T. H. FARRER,
Secretary.

THOMAS GRAY,
Assistant Secretary.

Consecutive Office Number (No. 179).
Departmental No. 986.
Examination No. 12.

BOARD OF TRADE,
Marine Department,
January, 1881.

NOTICE OF ALTERATIONS IN THE EXAMINATIONS OF MASTERS AND MATES.

From the 1st of August, 1881, Candidates for Second, Only, First Mates', and Masters' Certificates of Competency, will, in addition to the present requirements for these grades, be required to pass an examination in the subjects specified below.

IN NAVIGATION.

A *Second Mate* will be required to find the time of high water at a given port ; to observe and calculate the amplitude of the sun, and to find the error of the ship's compass therefrom, and also the deviation, the variation being given. He must also be able to find the daily rate of the chronometer from error observed, and to find the longitude by altitude of the sun by the usual methods.

An *Only Mate* will be required to find the true bearing of the sun, and the error of the ship's compass from an observed azimuth of the sun both from an altitude and also from the "Time Azimuth Tables," and with the variation given compute the deviation ; to find the latitude from a single altitude of the sun off the meridian, and also to ascertain the true bearing of the sun and the ship's position by Sumner's method by projection. He must also be conversant with the use of Mercator's chart, and be able to find, on either a *true* or *magnetic* chart, the course to steer, and the distance from one given position to another ; to find the ship's position on the chart from cross bearings of two objects ; from two bearings of the same object, the course and distance between the bearings being given ; and also to find the distance of the ship from the object at the time of taking the second bearings.

A *First Mate* will also be required to find the true bearing of the sun from the "Time Azimuth Tables," and with the variation given compute the deviation, and also work out the same problems, on either a *true* or *magnetic* chart, as are required of a candidate for an *Only Mate's* certificate. (See above.)

A *Master* will also be required to find the true bearing of the sun from the "Time Azimuth Tables," and with the variation given compute the deviation, and work out the same problems, on either a *true* or *magnetic* chart, as are required from the *Only* or *First Mate*. He will also be required to find the course to steer by compass in order to counteract the effect of a given current, and to find the distance the ship will make good towards a given point in a certain time, and to *work out practically* the correction to apply to soundings taken at a given time and place, to compare with the depth marked on the chart.

IN SEAMANSHIP.

Besides the subjects already prescribed in the rules for the ordinary Examinations, Candidates for Second, Only, First Mates', and Masters' Certificates of Competency, will be required to give satisfactory answers as to their knowledge of the additional subjects (applying more particularly to Steamships) which are specified in the Rules of Examination for Certificates of Competency for Foreign-going Steamships.

T. H. FARRER,
Secretary.

THOMAS GRAY,
Assistant Secretary.

NOTICE TO CANDIDATES.

1. Candidates are required to appear at the examination room punctually at the time appointed.

2. Candidates are prohibited from bringing into the examination room books or paper of any kind whatever. The slightest infringement of this regulation will subject the offender to all the penalties of a failure.

3. In the event of any candidate being detected in defacing, blotting, writing in, or otherwise injuring any book or books belonging to the Board, the papers of such candidate will be detained until the book or books so defaced be replaced by him. He will not, however, be at liberty to remove the damaged book, which will still remain the property of the Board.

4. In the event of any candidate being discovered copying from another, or affording any assistance or giving any information to another, or communicating in any way with another, during the time of examination, he will subject himself to a failure and its consequences.

5. No candidate will be allowed to work out his problems on a slate or on waste paper.

6. No candidate will be permitted to leave the room until he has given up the paper on which he is engaged.

7. Candidates will be allowed to work out the various problems by the method and tables they have been accustomed to use. At the expiration of the time allowed for the completion of the problems, as laid down in the Rules issued by the Board of Trade from time to time, they will, if they have not finished, be declared to have failed, unless the Local Marine Board or Examiner see fit to lengthen the period in any special case. If, however, the period is lengthened in any case, the special circumstances of that case and the reasons for lengthening the period will be reported to the Board of Trade by the Examiners at the time they send in the report on Form Exn. 14.

8. Candidates will find it more convenient, both here and at sea, to correct the declination and other elements from the Nautical Almanac by the "hourly differences" which have been given in that work in order to facilitate such calculations; they will thereby render themselves independent of any proportional or logarithmic table for such purpose. The candidates are referred to the "Explanation" given at the end of the Nautical Almanacs for further information on this subject.

9. The corrections by inspection from tables given in many works on navigation will not be allowed (see Tables IX., XI., and XXI. in Norie's Epitome, &c.); every correction must appear on the papers of the candidates.

10. Candidates are expected to bring their answers to all problems within, or not to exceed, a margin of one mile of POSITION from a correct result, with the exception of the ship's position by "Sumner's" method, where a margin of $2\frac{1}{2}$ miles may be allowed.

11. In finding the longitude by chronometer the logarithms used in finding the hour angle should be taken out for seconds of arc, also accuracy should be observed in computing the hour angles for the projection, by "Sumner's" method.

12. In all other problems the logarithms to the nearest minute will be sufficiently correct for all grades, except extra master, from whom a degree of precision will be required both in the work and in the results, beyond what is demanded from the inferior grades.

THOMAS GRAY,
Assistant Secretary.

Board of Trade,
Marine Department, 27th September, 1880.

EXAMINATIONS

OF

MASTERS AND MATES.

Notice to Examiners and Candidates.

The following Rules as to the time to be occupied by Candidates in their Examinations are to be substituted for those at present in force.

EXAMINATIONS FOR CERTIFICATES OF COMPETENCY FOR FOREIGN-GOING STEAMSHIPS.

Candidates for Second Mate's Certificates of Competency must complete the whole of their Examination in Navigation in *eight hours*, including the time allowed for writing the definitions (Exn. 4^a), the paper on the adjustment of the sextant, and the correction of *all* errors and oversights ; but the nautical problems on Forms "Exn. 4" and "Exn. 5" must be completed within *six hours*, and without the Candidates leaving the premises during that period.

Candidates for Only and First Mate's Certificates must complete the whole of their Examination in Navigation in *eleven and a half hours*, including the time allowed for the papers on the adjustment of the sextant, and the chart, and for the correction of *all* errors and oversights ; but the nautical problems on Forms "Exn. 4," "Exn. 5," and "Exn. 6" must be completed within *six hours*, and without the Candidates leaving the premises during that period.

Candidates for Master's Certificates must complete the whole of their Examination in Navigation in *fourteen hours*, including the time allowed for the papers on the sextant, the chart, and the compass deviation, and for the correction of *all* errors and oversights ; but the problems on Forms "Exn. 4," "Exn. 5," and "Exn. 6" must be completed within *six hours*, and without the Candidates leaving the premises during that period.

Candidates after finishing the problems required of the respective grades on the first day of Examination, should proceed, until the end of that day, with such subjects as the definitions, sextant, chart, and Question 19 of Form "Exn. 7."

The Summer Problem (Exn. 6) must on no account be given out to any of the grades on the first day of the Examination, but should be the commencement of the Candidate's work on the second day, and on completion of this problem the Candidates for Masters' Certificates should proceed with the problems on Paper "Exn. 7."*

EXAMINATIONS FOR CERTIFICATES FOR HOME TRADE
PASSENGER SHIPS.

On and after the 1st August next some alterations will be made in the Examinations for Home Trade Mates' and Masters' Certificates, and the time to be allowed Candidates for completing the whole of their arithmetical and chart papers must not exceed, in the case of the Mate five hours, and in that of the Master six hours.

EXAMINATIONS FOR THE ORDINARY FOREIGN-GOING
CERTIFICATES.

On and after the 1st August next Candidates for the Ordinary Foreign-going Certificates of Competency will be allowed the same amount of time to perform their navigation, &c., as hereinbefore laid down for the respective grades for Foreign-going Steamship Certificates.

EXAMINATIONS FOR CERTIFICATES OF COMPETENCY AS
MASTERS OF PLEASURE YACHTS.

Candidates for Certificates as Masters of Pleasure Yachts will be allowed the same amount of time for completing their Examinations as the Ordinary Masters.

Punctually at the expiration of the prescribed time all the papers should be called up, whether completed or not, and if not completed the Candidate will be declared to have failed, unless the Local Marine Board or the Examiners see fit to lengthen the period in any special case ; if however the period is lengthened in any case, the special circumstances of that case, and the reasons for lengthening the period, together with the time allowed, must be reported to the Board of Trade by the Examiners in the column for " remarks " on the Form "Exn. 14."

It is anticipated that but few of the Candidates for Certificates of Competency for any of the foregoing grades will require the whole of the time herein allowed for completing their Examination in Navigation ; and ample time has been prescribed, so that Candidates may perform their work in a careful, clear, and legible manner, and to the entire satisfaction of the Examiners.

THOMAS GRAY,
Assistant Secretary.

*Marine Department,
Board of Trade,
March 1881.*

SUPPLEMENT TO NAVIGATION.

PRELIMINARY NOTE

On the Degree of Dependence to be placed on the Results of Nautical Computations.

Raper, in page vii. of the preface to the 1st edition of his "Navigation," says, "Very indistinct and erroneous notions prevail among practical persons on the subject of accuracy of computation." We shall therefore give a few instances of the great errors that may arise from slight errors in the question, or from taking unsuitable data.

For example : Multiply 44110 by 225 by common logarithms. Now the log of 225 to 9 places of decimals is 2.352182518. Most writers on Navigation give this to 6 places, as 2.352183, which gives the answer to the preceding question as 9924750; but one writer gives the log of 225 as 2.352182, which gives the answer to the question as 9924727.27 nearly.

Thus the slight difference of 1 in the 6th decimal place of the log causes a difference of 22.93 nearly in the answer.

Exn. 4.

Port of _____

Rotation No.

EXAMINATION PAPER, No. I.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A

SECOND MATE.

This Paper to be used at the above Port this _____ day of _____ 18

Space for
Minor Correc-
tions.

1.—Multiply 47 by 25 by common logarithms.

47 log.....1.672098

25 log.....1.397940

1175 log.....3.070088

Table XXIV. Add the logs of the multiplicand and multiplier together, the sum is the log of the product.

See Bergen's Navigation, pages 17 and 19, Articles 15 and 20.

2.—Divide 2868 by 45 by common logarithms.

2868 log.....3.457579

45 log.....1.653213

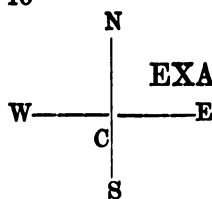
63.73 log.....1.804366

Table XXIV. Subtract the log of the divisor from the log of the dividend; the remainder is the log of the quotient.

See Bergen's Navigation, page 18, article 18.

The Candidate should sign his name in full at the foot of every page.

PAPER I.
EXAMINATION FOR SECOND MATE.



Space for Minor Corrections.

N 50° E
V 25° W } 41 W
D 16 W }
N 9 E

S 23° E
L. 3
—
S 20 E
V 25° W } 41 W
D 16 W }
S 61 E

S 39° E
L. 8
—
S 36 E
V 25° W }
D 22 W } 47 W
—
S 83 E

N 0° W
V 25° W } 13 W
D 12 E }
N 13 W

N 23° W
L. 8
—
N 26 W
V 25° W }
D 14 E } 11 W
—
N 37 W

S 68° E
L. 8
—
S 65° E
V 25° W } 42 W
D 17 W }
S 107 E
180

N 73 E

S 84° E
61 W
V 25° W }
D 26 W } S 135 E
180

N 45 E

S 6 E
V. 25 W
—
S 81 E

Hrs.	Courses.	Knts.	10ths	Winds.	Lee-way.	Dev.	Remarks.
1	S 23° E	6	3	E	3°	16° W	A Point, Bard Head in Lat. 60° 6' N Long. 1 4 W bearing by Compass S 50° W
2		6	5				
3		6	2				
4		6	0				
5	S 39° E	6	2	E.N.E.	3°	22° W	(Ship's Head S 23° E Deviation as per log) Dist. 12 miles.
6		6	3				
7		6	4				
8		7	1				
9	N	7	0	E.N.E.	0°	12° E	Variation 25° W
10		7	1				
11		6	9				
12		6	0				
1	N 23° W	6	1	N.E.	3°	14° E	A current set Correct Magnetic S 6° E
2		6	2				
3		6	3				
4		6	4				
5	S 68° E	6	4	N.E.	3°	17° W	17 miles from the time the departure was taken to the end of the day.
6		6	3				
7		6	2				
8		6	1				
9	S 84° E	7	2	N.N.E.	0°	26° W	
10		7	2				
11		7	4				
12		8	2				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

Corrected Courses.	Dist.	N.	S.	E.	W.
N 9° E	12	11.9		1.9	
S 61 E	25		12.1	21.9	
S 83 E	26		3.2	25.8	
N 13 W	27	26.3			6.1
N 37 W	25	20.0			15.0
N 73 E	25	7.3		23.9	
N 45 E	30	21.2		21.2	
S 81 E	17		14.6	8.8	
		86.7	29.9	103.5	21.1
		29.9		21.1	
		56.8		82.4	

Lat. left 60° 6' N

Diff. lat. 57 N

Long. left 1° 4' W

Diff. long. 2 48 E

Lat. in 61 3 N

Long. in 1 44 E

2) 121 9

Mid lat. 60 34

TO FIND THE DIFF. LONGITUDE.

Mid lat. 60° in Table II. and diff. 82.5 in lat col. give in dist. col. 165
 " 61 " 82.4 " 170

TO FIND COURSE AND DISTANCE.

The nearest dep. and diff. lat. to 82.4 and 56.8, in Table II. are dep. 82.9 and diff. lat. 55.9 which correspond to the course 56° at the bottom of the Table, and distance 100 in the dist. column. Hence we have Course N 56° E Distance 100 miles

2) 335

6,0) 16,7.5

diff long 2° 47'.5

Remarks. In the first, or departure course, Bard Head bears S 50°W from the ship, hence the ship bears N 50°E from Bard Head.

The Variation and Deviation are both W; hence their sum is W.

Draw two lines at right angles to represent the N, S, E and W points of the Compass. Conceive yourself at the centre of the Compass, look in the direction N 50° E, allow the sum of the W variation and W deviation to the left hand; thus the true course is found to be N 9° E.

The second course is S 23°E, look in that direction and allow the leeway from the wind, and proceed as in the example.

The fourth course is N, and the difference between W var. and E dev. is of the same name as the greater, namely W, and must be allowed to the left.

The sixth and seventh courses are each greater than 90°, take each of them from 180° and change their names.

The eighth course has only to be corrected for variation.

From a *Traverse Table* as is done in the example. The first corrected course, in the Table, is N 9° E, enter Table II. with 9° at the top of the Table, since 9° is less than 45°, and with the distance 12 in the column marked Dist., in the same line with 12 there are the numbers 11·9 and 1·9, in the columns marked Lat. and Dep. respectively, at the top of the Table.

As the course is N and E, put the Lat. 11·9 in the Traverse Table in the column marked N, and the Dep. 1·9 in the column marked E.

The next course is S 61° E, as 61° is greater than 45° it is found at the bottom of Table II., and opposite the distance 25, the Lat. and Dep. taken from the bottom of the Table are 12·1 and 21·9 respectively, put these numbers in the S and E columns respectively. Proceed with the other courses and distances in the same manner.

Add the numbers in the N, S, E and W columns together respectively; take the difference between the N and S column, and between the E and W column, respectively; these differences will be the diff. lat. and dep. made good respectively.

As the diff. lat. and lat. left are both of the same name, add them together their sum is the lat. in; add the lat. in to the lat. left, half their sum is the mid. lat. Proceed to find the diff. long. as in the question.

As the minutes of the mid. lat. are near half a degree, take half the sum of the distance found by mid. lats. 60 and 61 for the diff. long.

The Candidate should sign his name in full at the foot of every page.

PAPER I.

EXAMINATION FOR SECOND MATES.

- 4.—1877, March 20th, in longitude $96^{\circ} 12' E$, the observed meridian altitude of the Sun's Lower Limb was $50^{\circ} 52' 10''$ bearing North, index error $+ 1' 20''$, height of eye 18 feet.

Required the Latitude.

Space for Minor Corrections.	d. h. m. s.				° ' "	
	A.T.S. Mar.	20	0	0	0	Long. $96^{\circ} 12' E$
	Long. E.	—	6	24	48	4
	A.T.G. Mar.	19	17	35	12	6,0)88,4 48
				6.4		6 24 48
Var.	Dec.					° ' "
59.24	$0^{\circ} 0' 20'' N.$					Obs. alt. $50^{\circ} 52' 10'' N.$
6.4	6 19 S.					T.E. $+ 1' 20''$
23696						50 53 30
35544	0 5 59 S.					Dip. — 4 11 Table V.
6,0)87,9.136						50 49 19
6 19.1						Corr. — 0 42 Table VII.
						50 48 37
						Sem. $+ 16' 5'' N.A.$
						True alt $51^{\circ} 4' 42''$
						Z.D. $90^{\circ} 0' 0''$
						Dec. $98^{\circ} 55' 18'' S.$
						0 5 59 S.
						Latitude $89^{\circ} 1' 17'' South$

- 5.—In latitude $86^{\circ} 49'$ the departure made good was 471 miles.

Required the difference of Longitude by parallel sailing.

Lat. $86^{\circ} 49'$	Sec. 0.096608 Table XXV.
Dep. 471	Log 2.678021
Diff. long. 588.8	Log 2.769629

} Table XXIV.

REMARKS ON PARALLEL SAILING.

Add the Log Sec. of the lat., rejecting 10 in its index, and the log of the dep. together, the sum is the log of the diff. long.

Explain Meridian Altitude.

The Candidate should sign his name in full at the foot of each page.

REMARKS ON THE LATITUDE BY MERIDIAN ALTITUDE.

Multiply the long. by 4, the product is 384 48, divide 384 by 60, the quotient is 6 24, annex the 48 to this and the result is 6 24 48, which is the long. in time, in hours, minutes and seconds, and because it is E it must be subtracted from the given day, the remainder is the A.T.G.

Put down the hours of the long. in time, divide the minutes by 6, the result is the long. in time expressed in hours and decimals of an hour, 6.4 and it is the time from the noon of the 20th; that is, the nearest noon.

Take from page I. of the month in the Nautical Almanac, page 38 in the book, the Dec. $0^{\circ} 0' 20''$ N at noon of the given day, and the Var. $59.24''$ for 1 hour at that noon, the 20th.

Multiply the Var. by the long. in time, and divide the product by 60, the result is the correction $6' 19''$ of the Dec. due to the long. in time.

The Dec. on the 20th is N, and the Sun was further S on the 19th, therefore the correction is S.

Take the difference $0^{\circ} 5' 59''$ between the Dec. and the correction, this difference is the Dec. at the time of observation, and it must be marked S, because the S correction is greater than the N Dec. at the noon of the 20th.

Apply the Index order $+ 1' 20''$ to the obs. alt., according to its sign, subtract the dip. $- 4' 11''$, and corr. $- 0' 42''$ and add the sum $+ 16' 5''$, the result is the true alt., $51^{\circ} 4' 42''$, which subtract from 90° , the remainder $38^{\circ} 55' 18''$ is the zen. dist. S when the obs. alt. is N.

As the zen. dist. and Dec. are of the same name, add them together, the sum is the true alt.

The Candidate should sign his name in full at the foot of each page.

PAPER I.

EXAMINATION FOR SECOND MATES—(Continued).

Space for Minor
Corrections.

6.—Required the Course and Distance from A to B by calculation on Mercator's Principle.

Lat. of A	49° 42' N	Long. 1° 16' W
Lat. of B	51° 8' N	Long. 1° 20' E

A Lat.	49° 42' N	Mer. pts.	8447	Long.	1° 16' W
B Lat.	51° 8' N	Mer. pts.	8582	Long.	1° 20' E
	1 26	M.D.L.	185		2 86
	60				60

D. Lat.	86° N	D. Long.	156° E
---------	-------	----------	--------

D. Long.	156	log + 10	12.199125	Table XXIV.
M.D.L.	185	log	2.180884	Subtract Log m.d.l.

Course	49° 8'	tan.	10.062791	Table XXV.
--------	--------	------	-----------	------------

Course	49° 8'	sec.	0.184222	Table XXV.
D Lat.	86	log.	1.984498	Table XXIV.
Distance	181.4	log.	2.118720	

Course N 49° 8' E. Distance 181.4 miles.

Remarks—Subtract the log of M.D.L. from the log of D. Long.
the remainder is the tan. of the Course.

Add the log the D. Lat. to the sec. of the course, less 10
in its index, the sum is the log of the distance.

The Candidate should sign his name in full at the foot of every page.

REMARKS ON THE TIDES.

At page 107 of the Admiralty Tide Table for 1880, Gibraltar is found in connection with Brest, the Standard Port for Reference, and the Constant for Gibraltar is 2h. 0m.

Again, at page 42, under June and Brest, and on the line marked with 2, the day of the month, the time of the morning tide is given 11h. 32m., but a mark thus — is given for the Afternoon, which denotes that there is no tide at Brest on the Afternoon of the 2nd June, and it is said to be a *Blank Tide*.

Proceed, as in the example, to find the time of the Forenoon, or A.M., tide at Gibraltar. Then proceed to find the Afternoon, or P.M. tide as follows. The tide *after* the one that has been found is wanted. Take out of the Tide Tables the tide *after the one that was used* to find the Forenoon tide.

The time of tide the that was used to find the Forenoon tide is June 2d. 11h. 32m. A.M., and the time of the tide after it is June 3d. 0h. 5m. A.M., and by proceeding as in the question the time of the Afternoon tide at Gibraltar is found to be June 2d. 10h. 5m. P.M.

When there is a *Blank Tide*, the following two *Rules* are sufficient.—

Work from the tide that is given; then, if the A.M. tide required be found, work from the *next tide* in the Tables in order to find the P.M. tide required.

If the P.M. required be found, work from the *previous tide* for the A.M. required.

EXAMINATION FOR SECOND MATES.—(Continued)

Space for Minor Corrections.	
Daily Rate.	
Mar. 10	3 15 S
Mar. 18	2 27 S
8	8)48
Gaining daily 6	
See page 127 Bergen's Navigation.	
Var.	
7-06	
11-2	
1412	
7766	
6,0)7,9-072	
1 19-0	
Cosec.	
68 40 0	0-037055
	— 50
68 40 55	0-037005
Diff. 91	
55	
455	
455	
50-05	
Cos.	
68 36 0	9-562146
	— 183
68 36 34	9-561963
Diff. 537	
84	
2148	
1611	
182-58	
Sin.	
28 16 0	9-675390
	+ 82
28 16 21	9-675472
Diff. 391	
21	
391	
782	
82,11	

8.—1877, June 15th, A.M., at Ship in latitude 30° 12' N, The observed altitude of the Sun's L.L. was 40° 9' 45" height of eye 19 feet, time by a Chronometer June 14d. 11h. 17m. 5s. which was 8m. 15s. slow for mean noon at Greenwich on March 10th, and on March 18th was 2m. 27s. slow.

Required the longitude by Chronometer.

T. chron. June	d. h. m. s.	Mar. 31	d. h.
Slow	14 11 17 5	Mar. 18	11
	+		04
	14 11 19 82	Mar. 13	88-44
Gained	— 8 51	Apl. 30	6
M.T.G. June	14 11 10 41	May 31 h.	
		June 14 11	6,0)58,0-64
	11-2	88 11	8 50-6

Dec.	Eq. T.	Var.
23 17 46 N	m. s.	
+ 1 19	-0 0-58	0-529
	+ 5-92	11-2
23 19 5 N	+0 5-34	1058
90 0 0		5819
P.D. 66 40 55		5-9248

Obs. alt. 40 9 45	Alt. 40 20 13	
Dip. — 4 17	Lat. 30 12 0	sec. 0-063348
	P.D. 66 40 55	cosec. 0-037005

40 5 28	2)137 13 8	
40 4 26	68 36 34	cos. 9-561963
+ 15 47	28 16 21	sin. 9-675472

Sem. + 15 47	68 36 34	cos. 9-561963
	28 16 21	sin. 9-675472

True Alt. 40 20 13	h. m. s.	log. 9-337788
	20 17 31	97
	Eq. T. + 5	19=3
	d	
M.T.S. June 14	20 17 36	
M.T.G. June 14	11 10 41	
	9 6 55	
	60 120	

4)546 175 180

Longitude 186° 43' 45" East.

Remarks on the Correction for the hours of the elapsed time.

$\frac{1}{2} = .0416 = 1 \text{ hour expressed as the decimal of a day.}$

By Multiplying the hours of the elapsed time by .04, or by .042 if the elapsed time be great, or the rate high, they will be expressed as the decimal of a day without material error.

Remarks on the change of sign in the Equation of Time.

The M.T.G. is between the 14th and 15th June, on page 1 of the month in the N.A. the sign for the Equation of Time on the 14th is —, but for the 15th it is +. Mark the Eq. T. on the 14th—, and the correction +, take their difference and mark it +, the same as the sign of the greater, as in the question.

The Candidate should sign his name in full at the foot of every page.

PAPER I.

Exn. 6.

Port of _____

otation No.

EXAMINATION PAPER I.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS AN
ONLY MATE.

Space for Minor
Corrections.

Var.
5-65
5-5

2825
2825

31-075

Alt. 8° 30' 46"
Lat. 44° 2' 0"
P.D. 113 21 30

2)165 54 16

Hf. Sum 82 57 8
Diff. 30 24 22

22 41 50
2

T.Az.S 45 23 40 W

T.Az.S 45 24 W
M.Az.S 67 30 W

Err. 22 6 W
Var. 30 15 W

Dev. 8 9 E

1.—1877, December 26th, mean time at ship 3h. 21m. P.M. in latitude 44° 2' N, longitude 31° 37' W, the Sun's bearing by Compass WSW altitude L.L. 8° 24' 50", height of the eye 19 feet.

Required the True Azimuth, and Error of the Compass; and supposing the variation to be 30° 15' W, required the deviation of the Compass for that position of the Ship's head, both by the Sun's altitude and by the Time Azimuth Tables.

	d.	h.	m.	s.	
M.T.S. Decem.	26	3	21	0	Long 31 37 W
Long	+	2	6	28	4

M.T.G. Dec.	26	5	27	28	6,0)12,6 28
					2 6 28

Dec.

23	22	1 S	Obs. alt. 8° 24' 50"
—	31		Dip. — 4 17

23	21	30 S	8 20 33
90	0	0	Corr. — 6 5

P.D. 113 21 30

8 14 28
Sem. + 16 18

8 30 46

By the Altitude

sec. 0-004816
sec. 0-143810

By the Azimuth Tables.

	h.	m.	
M.T.S.	3	21 P.M.	57 1-2
Eq. T.	—	1	7 6

A.T.S.	3	20 P.M.	1 3 7-2
--------	---	---------	---------

Cos. 9-088970
Cos. 9-935766

A.T.S. 3h. 20m. P.M., lat. 44° N and Dec. 23° S
give True Az. N 134° 28' W
180

2)19-172862

or True Az. S	45	32 W
Mag. Az. S	67	30 W

Sin. 9-586481
179

Err.	21	58 W
Var.	30	15 W

503)25200(50
2515

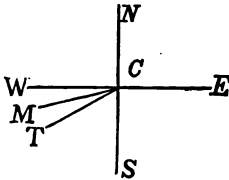
Deviation	8 17 East.
-----------	------------

50

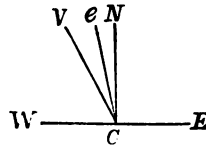
The Candidate should sign his name in full at the foot of every page.

Remarks.—The Board of Trade only require the logs of the arcs in this question to be taken out the nearest minute, therefore take the sec. of $8^{\circ} 81'$ for that of $8^{\circ} 80' 46''$, and so on. But as the half azimuth is multiplied by 2, and this sometimes causes an error of more than 1 minute of arc, it will therefore be advisable to find the seconds of the half azimuth; as is done in the question.

Figure for error



T to left of M
error W



e right of v
deviation E

See page 148 Bergen's Navigation.

The deviation may be found by conceiving the name of the variation to be changed from *W* to *E*, it is then of different name to the error, take the difference for the deviation, and name it *E*, the same as the greater.

By the Azimuth Tables.—The M.T.S. is 8h. 21m. P.M., reduce this to A.T.S. as follows; the equation of time on page II. of the month, on the 26th of December is 57s., the var. at page I. is 1.2 which multiplied by the hour of the M.T.G. gives $1.2 \times 5 = 6s.0.$, 6s. added to 57s. is equal to 1m. 8s.; which according to the precept at the top of the page, is the correction to be subtracted from the equation of time to reduce the M.T.S. to A.T.S. Enter Burdwood's Azimuth Tables at page 44, and proceed as in the question.

The Candidate should sign his name in full at the foot of every page.

PAPER I.

EXAMINATION FOR ONLY MATE—Continued.

Space for Minor
Corrections.

2.—1877, March 20th A.M., at Ship lat. by account $84^{\circ} 17'$ N, long. 158° E, the observed altitude of the Sun's L.L. South of the observer was $54^{\circ} 59'$ I.E.,— $3' 40''$, height of eye 18 feet. Time by watch March 19d. 22h. 18m., which had been found to be slow of apparent time at Ship 1h. 20m. 18s. The difference of Longitude made to the West was 28' after the error on Apparent time at Ship was determined.

Required the latitude by the Reduction to the Meridian.

	d.	h.	m.	s.			
T. watch Mar.	19	22	18	0	D.L.	28'W	Long $158^{\circ} 0' E$
Slow.	+	1	20	18		4	4
	19	23	38	18			
Diff. long.	—		1	52	6,0)11,2		6,0)63,2 0
					1 52		10 32 0
A.T.S. Mar.	19	23	36	26			
Long E.	—	10	32	0		h. m. s.	
						24 0 0	
A.T.G. Mar.	19	13	4	26	A.T.S.	23 36 26	
	20	0	0	0			
	10	55	34		T. fr. noon	23 34	
	10	9					

Var.
59.24
10.9
53816
59240
6,0)645.716
10 45.7

0 0 20 N
0 10 46 S
0 10 26 S

Obs. alt. $54^{\circ} 59' 0'' S$
I. E. — $3' 40''$
Dip. — $4' 11''$
Corr. — $0' 36''$
Sem. + $16' 5''$
True alt. $55^{\circ} 6' 38'' S$

m. s. Rising.

23 30 } 2-72036
4 } + 260
23 34 } 2-72296

T. from noon m. s.
23 34
Lat. acc. $34^{\circ} 17' N$
Dec. 0 10 S

rising 2-72296
cos. 9-917118
eos. 9-999998
const. 1.

True alt. 55 7 S Nat. number 4366 log. 3-640076
Nat. sin. 820818
M.Z.D. 34 27 N Nat. cos. 924684
Dec. 0 10 S
Latitude 34 17 North.

Remarks.—The cosines must be taken out of the Table to 6 places of figures, and the constant number 1 added, as in the question.

See Article 103, pages 156 and 157 Bergen's Navigation.

The Candidate should sign his name in full at the foot of every page

Exn. 7.
(Late E.F. 4.)

Port of _____

Rotation No.

EXAMINATION PAPER I.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A
MASTER ORDINARY.

To be used at the above Port this _____ day of _____ 18

N.B.—A Candidate for an Ordinary Master's Certificate of Competency will be required to work the Questions in Papers Exn. 4, Exn. 5, and Exn. 6, in addition to the Questions in this Paper.

Space for Minor
Corrections.

1.—1877, August 29th. The observed Meridian Altitude of the Star α Coronae (Alphacca) bearing South was $57^{\circ} 18' 20''$, height of the eye 21 feet.

Required the Latitude.

Obs. Alt.	57	18	20	S
Dip.	—	4	31	Table V.
	57	18	49	
Ref.	—	0	88	Table IV.
True Alt.	57	18	11	
	90	0	0	
Zen. dist.	82	46	49	N
Naut. Alman. Dec.	27	7	45	N page 852
Latitude	59	54	84	North

Remarks.—It is convenient to look for the right Ascension of the Star in the Table of the "Mean Places of Stars" pages 298 to 295 Nautical Almanac, and then follow the R.A. at the top of the Table for the "Apparent Places of Stars," pages 818 to 869.

The Candidate should sign his name in full at the foot of every page.

EXAMINATION PAPER, NO. I.

FOR SECOND MATE.

1. Multiply 887 by 281, by common logarithms.
2. Divide 5.782 by 2.154, by common logarithms.
- 8.

Hrs.	Courses.	Knts. 10ths		Winds.	Lee-way.	Devia-tion.	Remarks, &c.
1	S. 42° W.	6	9	W.N.W.	11°	8° W.	A point in Lat. 34° 21' S., Long. 115° 6' E.
2		7	1				
3		7	6				
4		7	4				
5	S. 22° W.	6	3	West.	10°	3° W.	bearing by Compass N. 47° E. Dist. 18 miles.
6		6	2				
7		6	1				
8		5	4				
9	S. 24° E.	6	4	S.W.	9°	10° E.	(Ship's head S. 42° W., Deviation as per log.)
10		6	3				
11		6	2				
12		5	1				
1	S. 30° E.	6	9	S.S.W. ½ W.	7°	11° E.	Variation 7° W.
2		6	1				
3		6	6				
4		5	4				
5	N. 84° W.	5	2	S.S.W.	6°	22° W.	A Current set } S. 32° W correct magnetic }
6		5	3				
7		5	4				
8		5	1				
9	N. 47° W.	4	3	W.S.W.	5°	22° W.	25 miles from the time the departure was taken to the end of the day.
10		4	3				
11		4	2				
12		4	2				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in by inspection.

4. 1884, January 8rd. In Longitude 25° 50' W. The observed meridian altitude of the Sun's Lower Limb was 52° 18' 10", bearing South, index error + 1' 10", height of eye 14 feet.

Required the Latitude ?

5. In Latitude 62° 48', the Departure made good was 79 miles.

Required the Difference of Longitude by parallel sailing ?

6. Required the course and distance from A to B, by calculation on Mercator's principle ?

Lat. of A..... 50 55 N.

Long..... 0 58 E.

Lat. of B..... 49 11 N.

Long..... 2 7 W.

The Candidate should sign his name in full at the foot of every page.

7. 1880, July 1st. Find the time of High Water, at Fowey A.M. and P.M.

8. 1884, January 2nd. At 7h. 85m. A.M., Appt. Time at Ship, in latitude $42^{\circ} 0' N.$, Longitude $17^{\circ} 1' W.$ The Sun's Magnetic Amplitude was S.S.E.

Required Amplitude and Error of the Compass; and supposing the Variation to be $28^{\circ} 50' W.$?

Required the Deviation of the Compass for that position of the Ship's head?

9. 1884, January 2nd P.M. at Ship, in Latitude $42^{\circ} 16' S.$ The observed altitude of the Sun's L.L. was $41^{\circ} 48'$, I.E. $+ 2' 20''$, height of eye 16 feet. Time by a chronometer 2d. 5h. 10m. 16s., which was slow for mean noon at Greenwich 1m. 15s. on December 18th, 1883, and on December 26th was 1m. 2s. slow for mean noon at Greenwich.

Required the Longitude by Chronometer?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, February 8th. At 8h. 55m. 17s. A.M., Mean Time at Ship, in latitude $86^{\circ} 12' S.$, longitude $9^{\circ} 46' E.$ The Sun's bearing by Compass was E. $\frac{1}{4}$ N. the altitude of its L.L. $40^{\circ} 54'$, height of the eye 18 feet.

Required the True Azimuth and Error of the Compass; and supposing the Variation to be $27^{\circ} 30' W.$ Required the Deviation of the Compass for that position of the Ship's head; both from the altitude, and also from the Azimuth Tables?

11. 1884, February 8th, A.M. at Ship, in lat. by account $15^{\circ} 6' N.$, long. $18^{\circ} 22' W.$ The observed altitude of the Sun's L.L. South of the observer was $59^{\circ} 4' 20''$ I.E.— $0' 20''$, height of eye 17 feet. Time by watch 7d. 28h. 36m. 14s., which had been found to be 1m. 24s. fast of apparent time at Ship.

The difference of longitude made to the East was 9 miles after the error on Apparent Time at Ship was determined.

Required the Latitude by Reduction to the Meridian?

ADDITIONAL FOR MASTER.

12. 1884, January 11th. The observed Meridian Altitude of the Star γ Pegasi (Algenib) was $42^{\circ} 17'$ bearing South, height of the eye 14 feet.

Required the Latitude?

The Candidate should sign his name in full at the foot of every page.

EXAMINATION PAPER, NO. II.

FOR SECOND MATE.

1. Multiply 41.68 by 205.7, by common logarithms.
2. Divide .7006 by .0247 by common logarithms.
- 8.

Hrs.	Courses,	Knts.	10ths	Winds.	Lee-way.	Devia-tion.	Remarks, &c.
1	S.E. $\frac{1}{2}$ E.	5	1	S.S.W.	$1\frac{1}{2}$	15° E.	A point, in Lat. $50^{\circ} 24' N.$, Long $179^{\circ} 15' W.$ bearing by Compass N.E. by N.
2		5	2				
3		5	3				
4		5	4				
5	E.S.E.	6	4	South.	$1\frac{1}{2}$	18° E.	Dist. 17 miles.
6		7	3				
7		7	5				
8		7	8				
9	E. $\frac{1}{2}$ S.	7	5	S.S.E.	$2\frac{1}{2}$	20° E.	(Ship's head S.E. $\frac{1}{2}$ E., Deviation as per log.)
10		6	4				
11		5	5				
12		4	6				
1	E. by N.	4	1	S.E. by S.	$2\frac{1}{2}$	20° E.	Variation 14° E.
2		4	2				
3		3	7				
4		2	0				
5	W.S.W.	2	1	S. by E.	$\frac{3}{4}$	16° W.	A current set correct magnetic. } S.S.E. $\frac{1}{2}$ E.
6		2	4				
7		3	3				
8		4	2				
9	W.N.W.	5	4	S.W.	$\frac{1}{2}$	24° W.	34 miles from the time the departure was taken to the end of the day.
10		6	6				
11		7	6				
12		8	4				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

4. 1884, February 9th, in Longitude $110^{\circ} 29' E.$ The observed Meridian Altitude of the Sun's Lower Limb was $61^{\circ} 14' 30''$ bearing North, index error — $1' 20''$, height of the eye 18 feet.

Required the Latitude ?

5. In latitude $18^{\circ} 18'$, the Departure made good was 271 miles.

Required the difference of Longitude by parallel sailing ?

The Candidate should sign his name in full at the foot of every page.

6. Required the course and distance from A to B by calculation on Mercator's principle ?

A Lat..... $55^{\circ} 7' N.$
 B Lat..... $57^{\circ} 44' N.$

Long..... $1^{\circ} 30' W.$
 Long..... $10^{\circ} 38' E.$

7. 1880, July 2nd. Find the Time of High Water at Bayonne, A.M. and P.M.

8. 1884, February 8th. At 7h. 51m. P.M., Appt. T. Ship, in latitude $61^{\circ} 15' S.$, longitude $80^{\circ} E.$ The Sun's Magnetic Amplitude was $W. 7^{\circ} 30' S.$

Required True Amplitude and Error of the Compass; and supposing the Variation to be $45^{\circ} 18' W.$ Required the Deviation of the Compass for that position of the Ship's head ?

9. 1884, February 8th A.M. at Ship, in latitude $36^{\circ} 12' S.$ The observed Altitude of the Sun's L.L. was $40^{\circ} 54' 0''$, height of eye 18 feet. Time by Chronometer 7d. 20h. 16m. 12s., which was 2m. 24s. fast for mean noon at Greenwich, October 20th, 1883, and on December 15th, 1883, was 1m. 10s. fast for mean noon at Greenwich ?

Required the Longitude by Chronometer ?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, January 2nd. At 8h. 37m. 48s. P.M., Mean Time at Ship, in latitude $42^{\circ} 16' S.$, longitude $28^{\circ} 21' W.$ The Sun's bearing by Compass was W.N.W., the altitude of its L.L. $41^{\circ} 43'$, I.E. $+ 2^{\circ} 20'$, height of the eye 16 feet

Required the True Azimuth and Error of the Compass; and supposing the Variation to be $5^{\circ} 30' W.$ Required the Deviation of the Compass for that position of the Ship's head ? Both from the Altitude and also from the Azimuth Tables.

11. 1884, January 2nd, P.M. at Ship, in lat. by account $7^{\circ} 28' N.$, long. $12^{\circ} 2' W.$ The observed Altitude of the Sun's L.L. South of the observer was $59^{\circ} 18' 40''$, height of eye 22 feet. Time by watch 1d. 23h. 23m. 42s., which had been found to be 50m. 40s. slow of Apparent Time at Ship.

The difference of Longitude made to the West was 80 miles after the error on Apparent Time at Ship was determined.

Required the Latitude by Reduction to the Meridian.

ADDITIONAL FOR MASTER.

12. 1884, February 20th. The observed Meridian Altitude of the Star α Eridani (Achernar) was $32^{\circ} 16' 10''$, bearing South, I.E. $+ 2^{\circ} 40''$, height of the eye 22 feet.

Required the Latitude ?

The Candidate should sign his name in full at the foot of every page.

EXAMINATION PAPER, NO. III.

FOR SECOND MATE.

1. Multiply 84000 by 82000, by common logarithms.
2. Divide 8742 by 27, by common logarithms.
- 8.

Hrs.	Courses.	Knts	10ths	Winds.	Lee-way.	De-via-tion.	Remarks, &c.
1	S. 46° E.	4	2	N. 67° E.	2°	18° W	A point, Flambro' Head, in Lat. 54° 7' N., Long. 0° 5' W., bearing by Com- pass S. 56° W.
2		3	4				
3		6	3				
4		6	1				
5	S. 50° E.	6	3	N. 63° E.	3°	18° W	Dist. 17 miles.
6		5	2				
7		4	1				
8		2	4				
9	S. 25° E.	2	1	N. 87° E.	5°	12° W	(Ship's head S. 46° E., Deviation as per log.)
10		3	5				
11		7	3				
12		8	1				
1	N. 67° E.	8	4	S. 48° E.	7°	16° W	Variation 20° W.
2		7	3				
3		6	2				
4		5	1				
5	N. 28° E.	3	4	S. 82° E.	11°	8° W	Tide estimated to set correct magnetic N. 34° E.
6		4	5				
7		5	1				
8		6	0				
9	N. 18° W.	6	3	N. 48° E.	13°	2° E	Dist. 9 miles the last 24 hours.
10		6	2				
11		5	1				
12		4	4				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude, by Inspection.

4. 1884, March 20th. In Longitude 148° 0' E. The observed Meridian Altitude of the Sun's Lower Limb was 51° 14' 20" bearing South, index error — 2' 10", height of eye 10 feet.

Required the Latitude ?

5. In latitude 54° 17', the Departure made good was 142 miles.

Required the Difference of Longitude by parallel sailing ?

The Candidate should sign his name in full at the foot of every page.

6 Required the course and distance from A to B, by calculation on Mercator's principle?

A Lat.....	50° 35' N.	Long.....	2° 3' W.
B Lat.....	49° 42' N	Long.....	1° 16' W.

7. 1880, July 8th. Find the Time of High Water at Selsea Bill, A.M. and P.M.

8. 1884, March 20th. At 6h. 5m. A.M., Appt. T. Ship, in latitude $32^{\circ} 16' N$. longitude $25^{\circ} 42' E$. The Sun's Magnetic Amplitude was $N 7\frac{1}{2} E$.

Required True Amplitude and Error of the Compass; and supposing the Variation to be $10^{\circ} 40' W$. Required the Deviation of the Compass for that position of the Ship's head?

9. 1884, March 19th, P.M. at Ship, in latitude $32^{\circ} 4' N$. The observed altitude of the Sun's L.L. was $25^{\circ} 15' 40''$, height of eye 19 feet. Time by a chronometer 19d. 15h. 40m. 6s., which was 0m. 3s. slow for mean noon at Greenwich on December 24th, 1883, and on January 5th, 1884, was 0m. 15s. fast for mean noon at Greenwich.

Required the Longitude by Chronometer?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, December 24th. At 8h. 34m. 29s. A.M., Mean Time at Ship in latitude $38^{\circ} 14' S$, longitude $80^{\circ} 50' E$. The Sun's bearing by Compass was E. by S. $\frac{1}{4} S$, altitude of its L.L. $43^{\circ} 56'$, height of the eye 23 feet.

Required the True Azimuth and Error of the Compass, and supposing the Variation to be $20^{\circ} 10' W$. Required the Deviation of the Compass for that position of the Ship's head? Both by the Altitude, and also by the Time Azimuth Tables.

11. 1884, December 23rd, A.M. at Ship, lat. by account $53^{\circ} 49' S$, longitude $48^{\circ} 52' W$. The observed altitude of the Sun's L.L. North of the observer was $58^{\circ} 58'$, index error $+ 1' 20''$, height of eye 23 feet. Time by watch 22d. 23h. 37m. 48s., which had been found to be 8m. 42s. fast of apparent time at Ship.

The difference of longitude made to the West was 24 miles after the error on Apparent Time at Ship was determined.

Required the Latitude by the Reduction to the Meridian?

ADDITIONAL FOR MASTER.

12. 1884, March 9th. The observed Meridian Altitude of the Star α Tanri (Aldebaran) bearing North was $52^{\circ} 10' 40''$, height of the eye 20 feet.

Required the Latitude?

The Candidate should sign his name in full at the foot of every page

EXAMINATION PAPER, NO. IV.

FOR SECOND MATE.

1. Multiply 4.721 by 9850, by common logarithms.
2. Divide 6781 by 285, by common logarithms.
- 3.

When the ship changes her longitude from E. to W., or from W. to E., so that the longitude exceeds 180° , as in the following exercise, take the longitude from 360° , change the name of the remainder and it is the longitude in.

Hrs.	Courses.	Knts.	10ths	Winds.	Lee-way.	Devia-tion.	Remarks, &c.
1	S. 79° E.	10	9	S. $\frac{1}{4}$ E.	3°	19° E.	A point, in Lat. - $47^\circ 44'$ S. Long. $179^\circ 7'$ E.
2		11	0				
3		11	2				
4		11	4				
5		11	5				
6	S. 87° E.	12	0	S. $\frac{1}{4}$ E.	6°	20° E.	bearing by Compass, N 17° W Dist. 21 miles.
7		12	1				
8		12	2				
9		12	3				
10		12	4				
11	S. 67° E.	13	4	S. S. W.	8°	18° E.	(Ship's head S. 79° E. Deviation as per log.) Variation 14° E.
12		13	5				
1		13	5				
2		14	1				
3		14	5				
4	N. 56° E.	13	9	North.	4°	19° E.	A current set, } N. 34° W. correct magnetic.
5		13	6				
6		13	5				
7		13	7				
8		13	3				
9	S. 48° E.	12	5	S. W. by S.	8°	15° E.	23 Miles from the time the departure was taken to the end of the day.
10		12	5				
11	N. 11° E.	2	4	E. N. E.	65°	2° E.	
12		2	6				

Correct the Courses for Deviation, Variation and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

4. 1884, April 14th. In Longitude $91^\circ 42'$ E. The observed meridian Altitude of the Sun's Lower Limb was $89^\circ 57' 20''$ bearing South, index error — $2' 40''$, height of the eye 17 feet.

Required the Latitude ?

The Candidate should sign his name in full at the foot of every page.

5. In latitude $78^{\circ} 14'$, the Departure made good was 149 miles.

Required the Difference of Longitude by parallel sailing ?

6. Required the course and distance from A to B by calculation on Mercator's principle ?

Lat. of A.....	$50^{\circ} 26' N.$	Long.....	$2^{\circ} 58' W.$
Lat. of B.....	$71^{\circ} 10' N.$	Long.....	$25^{\circ} 46' E.$

7. 1880, July 1st. Find the time of High Water at Falmouth, A.M. and P.M.

8. 1884, April 15th. At 7h. 11m. P.M., Appt. T. Ship, in latitude $59^{\circ} 12' N.$, longitude $178^{\circ} 20' E.$ The Sun's Magnetic Amplitude was $N 6\frac{1}{2} W.$

Required True Amplitude and Error of the Compass, and supposing the Variation to be $14^{\circ} 25' E.$ Required the Deviation of the Compass for that position of the Ship's head.

9. 1884, April 14th, P.M. at Ship, in latitude $48^{\circ} 14' N.$ The observed altitude of the Sun's L.L. was $35^{\circ} 35' 10''$, index error — 1m. 80s., height of eye 17 feet. Time by a chronometer 14d. 11h. 32m. 15s., which was 2m. 15s. fast for mean noon at Greenwich on March 6th, and on March 26th was 3m. 51s. fast for mean noon at Greenwich.

Required the Longitude by Chronometer ?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, November 28th. At 3h. 24m. 4s. P.M., Mean Time at Ship, in latitude $42^{\circ} 17' N.$, longitude $81^{\circ} 29' W.$ The Sun's bearing by Compass was S.W. $\frac{1}{4} W.$, altitude of its L.L. $8^{\circ} 59'$, I. E. + $4^{\circ} 10''$, height of the eye 19 feet.

Required the True Azimuth and Error of the Compass; and supposing the Variation to be $11^{\circ} 20' W.$ Required the Deviation of the Compass for the position of the Ship's head. Both by the Sun's Altitude and by the Time Azimuth Tables ?

11. 1884, November 29th, A.M. at Ship, lat. by account $54^{\circ} 35' S.$, long. $86^{\circ} W.$ The observed altitude of the Sun's L.L. North of the observer was $56^{\circ} 10'$, height of eye 17 feet. Time by watch 29d. 0h. 6m., which had been found to be 42m. 28s. fast of Apparent Time at Ship.

The difference of longitude made to the East was 14 miles, after the error on Apparent Time at Ship was determined.

Required the Latitude by Reduction to the Meridian ?

ADDITIONAL FOR MASTER.

12. 1884, April 21st. The observed Meridian Altitude of the Star α Aurigæ (Capella) bearing North was $29^{\circ} 16' 45''$, index error — $2' 15''$, height of the eye 18 feet.

Required the Latitude ?

The Candidate should sign his name in full at the foot of every page.

EXAMINATION PAPER, NO. V.

FOR SECOND MATE.

1. Multiply 845.1 by 27.54, by common logarithms.

2. Divide .0847 by .672, by common logarithms.

Note. Solve this question by both common and negative indices.

3.

Hrs.	Courses.	Knts.	10ths	Winds.	Lee-way.	Devia-tion.	Remarks, &c.
1	N. 23° E.	6	5	E.	3°	18°E.	A point in Lat. 57° 42' N. Long. 2 2 W. bearing by Compass, N. 68° W.
2		6	6				
3		6	9				
4		6	3				
5		6	9				
6		7	2				
7		7	9				
8	N. 6° E.	7	6	E.N.E.	6°	12°E.	Dist. 20 miles.
9		7	3				
10		7	3				
11		7	6				
12	N. 3° W.	7	4	E.N.E.	8°	10°E.	(Ship's head N. 23° E. Deviation as per log.)
1		7	5				
2	E.	7	7	N.N.E.	14°	16°E.	Variation 26° W. A Current set, correct magnetic. } N. 45° E
3		7	5				
4		7	3				
5		7	2				
6		7	4				
7		7	1				
8	S. 68° E.	7	4	N.E.	17°	7°E.	16 miles from the time the departure was taken to the end of the day.
9		7	8				
10	S. 45° E.	7	7	E.N.E.	25°	3°W	
11		7	2				
12		7	2				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and find the Latitude and Longitude in, by Inspection.

4. 1884, May 21st. In Longitude 175° 44' E. The observed meridian altitude of the Sun's Lower Limb was 54° 18' 20", bearing South, index error 0, height of eye 22 feet.

Required the Latitude ?

In Latitude 84° 49' the Departure made good was 89 miles.

Required the Difference of Longitude by parallel Sailing ?

The Candidate should sign his name in full at the foot of every page.

6. Required the Course and Distance from A to B by Calculation on Mercator's principle.

A Lat..... $42^{\circ} 15'$ N.
B Lat..... $38^{\circ} 54'$ N.

Long..... $8^{\circ} 40'$ W.
Long..... $71^{\circ} 89'$ W.

7. 1880, July 2nd. Find the time of High Water at Arcachon, A.M. and P.M.

8. 1884, May 20th. At 7h. 24m. A.M., Appt. T. Ship, in latitude $46^{\circ} 14'$ S., longitude $125^{\circ} 16'$ W. The Sun's observed Amplitude was N E, by E.

Required the True Amplitude and Error of the Compass ; and supposing the Variation to be $12^{\circ} 45'$ E. Required the Deviation of the Compass for that position of the Ship's head ?

9. 1884, May 20th P.M. at Ship, in latitude $21^{\circ} 4'$ S. The observed Altitude of the Sun's L.L. was $24^{\circ} 12'$, height of eye 17 feet. Time by a chronometer 20d. 5h. 10m. 16s., which was 2m. 14s. fast of Greenwich mean noon on January 25th, and on April 16th, was 1m. 22s. slow for mean noon at Greenwich?

Required the Longitude by Chronometer ?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, October 27th. At 8h. 5m. 6s. A.M., Mean Time at Ship, in latitude $88^{\circ} 17'$ S, Longitude $55^{\circ} 36'$ E. The Sun's bearing was E. by S. $\frac{1}{4}$ S. the altitude of its L.L. $86^{\circ} 18'$, Height of the Eye 16 feet.

Required the True Azimuth and Error of the Compass ; and supposing the Variation to be $24^{\circ} 20'$ W. Required the Deviation of the Compass for that position of the Ship's head.

11. 1884, October 25th, A.M. at Ship, lat by account $29^{\circ} 35'$ N. Long $24^{\circ} 16'$ W. The observed altitude of the Sun's L.L. near the meridian was $47^{\circ} 50'$ bearing S. I.E. $+ 1^{\circ} 40''$, Height of the eye 19 feet, Time by watch 25d. 1h. 58m, which had been found to be 2h. fast on apparent time at Ship. The difference of longitude made to the West was 6 miles, after the Error on Apparent Time at Ship was determined.

Required the Latitude by Reduction to the Meridian ?

ADDITIONAL FOR MASTER.

12. 1884, May 18th. The observed Meridian Altitude of the Star β Orionis (Rigel) bearing South was $64^{\circ} 27' 10''$. Height of the eye 19 feet, Required the Latitude ?

The Candidate should sign his name in full at the foot of every page.

EXAMINATION PAPER, NO. VI. FOR SECOND MATE.

1. Multiply .006484 by .000721, by common logarithms.

2. Divide 94.72 by .1214, by common logarithms.

Note. Solve the two preceding questions by both common and negative indices?

8.

Hrs.	Courses.	Knts.	10ths	Winds.	Lee-way.	Devia-tion.	Remarks, &c.
1	N. 84° W.	4	0	S. S. W.	3°	19° W	A point, in Lat. - 14° 26' S. Long. 129 37 W.
2		4	7				
3		4	5				
4		4	8				
5	S. 68° W.	4	6	N. W.	6°	14° W	bearing by Compass, S.,
6		4	9				
7		5	5				
8	S. 45° E.	5	7	S. S. W.	14°	7° E	Dist. 22 miles.
9		5	9				
10		6	3				
11	N. 89° W.	7	7	W. S. W.	17°	17° W	(Ship's head, N. 84° W. Deviation as per log.)
12		7	9				
1		8	2				
2		9	2				Variation 8° E.
3	N. 79° W.	9	9	S. W. by S.	20°	20° W	A current set, } S. 45° W correct magnetic. }
4		9	6				
5		9	9				
6		10	1				
7		10	3				
8		10	5				
9		10	2				
10		10	5				
11	N. 79° W.	10	4	S. W. by S.	28°	20° W	
12		10	6				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in by Inspection.

4. 1884, June 14th. In Longitude 176° 29' E. The observed meridian altitude of the Sun's Lower Limb was 89° 56' 30", bearing North, index error 0, height of the eye 15 feet.

Required the Latitude?

5. In latitude 85° 36', the Departure made good was 246 miles.

Required the Difference of Longitude by parallel sailing?

The Candidate should sign his name in full at the foot of every page

6. Required the Course and Distance from A to B, by Calculation on Mercator's principle ?

Lat..... of A. $37^{\circ} 8' N$.

Long..... $9^{\circ} 0' W$.

Lat..... of B. $36^{\circ} 19' S$.

Long..... $56^{\circ} 45' W$.

7. 1880, July 8th. Find the time of High Water at Poole, A.M. and P.M.

8. 1884, June 18th. At 0h. 44m. 8s. A.M. Appt. T. Ship, in latitude $66^{\circ} 4' N$. Longitude $2^{\circ} 42' E$. The Sun's Magnetic Amplitude was $N \frac{1}{2} E$.

Required True Amplitude and Error of the Compass ; and supposing the Variation to be $20^{\circ} 15' W$. Required the Deviation of the Compass for that position of the Ship's head ?

9. 1884, June 14th. A.M. at Ship, in latitude $34^{\circ} 16' S$. The observed altitude of the Sun's L.L. was $12^{\circ} 48'$, Height of Eye 20 feet. Time by a Chronometer 18d. 17h. 10m. 42s, which was 2m. 47s. slow for mean noon at Greenwich, on February 3rd, and on April 22nd was 1m 10s fast for mean noon at Greenwich.

Required the Longitude by Chronometer ?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, September 22nd. At 3h. 15m. 36s. P.M. Mean Time at Ship, in latitude $32^{\circ} 16' S$. longitude $107^{\circ} 56' W$. The Sun's bearing by Compass was W by $N \frac{1}{2} N$, the altitude of its L.L. $32^{\circ} 16' 40'' I. E$.— $1' 10''$, Height of Eye 21 feet.

Required the True Azimuth and Error of the Compass ; and supposing the Variation to be $12^{\circ} 30' E$. Required the Deviation of the Compass for that position of the Ship's head ? Both by the Sun's altitude, and also by the Time Azimuth Tables.

11. 1884, September 22nd, P.M. at Ship, Lat. by account $44^{\circ} 42' N$. Long $170^{\circ} 30' W$. The observed altitude of the Sun's L.L. South of the observer was $44^{\circ} 44'$, height of the eye 13 feet. Time by Chronometer 0h. 47m. 15s. which had been found to be 28m. 42s. fast of apparent time at Ship.

The difference of longitude made to the East was 26.5 miles, after the error on Apparent Time at Ship was determined.

Required the Latitude by the Reduction to the Meridian ?

ADDITIONAL FOR MASTER.

12. 1884, June 10th. The observed Meridian Altitude of the Star α Argus (Canopus) bearing South was $78^{\circ} 42' 15''$, index error $+ 2' 10''$. Height of the Eye 21 feet.

Required the Latitude ?

EXAMINATION PAPER, NO. VII.

FOR SECOND MATE.

1. Multiply $\cdot 0000972$ by $1547\cdot6$, by common logarithms.

2. Divide $27\cdot41$ by 8764 by common logarithms.

Note. Solve No. 1 both by common and negative indices.

8.

Hrs.	Courses.	Knts.	10ths	Winds.	Lee-way.	Devia-tion.	Remarks, &c.
1	E. N. E.	8	7	North.	$\frac{1}{2}$	11° E.	A point in Lat. $32^{\circ} 18'$ S, Long. $178^{\circ} 14'$ E., Bear- ing by compass West. Dist. 24 miles.
2		8	9				
3		8	8				
4		8	4				
5	E. by N.	8	8	N. $\frac{1}{2}$ E.	$2\frac{1}{2}$	17° E.	(Ship's head E. N. E. Deviation as per log.)
6		8	8				
7		8	9				
8		9	6				
9	E. $\frac{1}{2}$ N.	8	6	N. by E.	$1\frac{1}{2}$	15° E.	Variation 14° E.
10		8	4				
11		8	6				
12		8	7				
1	E. by N. $\frac{1}{2}$ N.	8	7	S. E.	$\frac{3}{4}$	12° E.	A current set. Correct } E. $\frac{3}{4}$ N. magnetic.
2		8	8				
3		8	5				
4		8	6				
5	E. by S.	8	7	S. by E.	$4\frac{1}{2}$	24° E.	18 miles from the time the departure was taken to the end of the day.
6		8	5				
7		8	4				
8		9	6				
9	E. $\frac{1}{2}$ S.	8	7	S. by E.	$3\frac{3}{4}$	22° E.	
10		8	8				
11		9	3				
12		9	4				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

4. 1884, July 22nd. In Longitude $28^{\circ} 16'$ W. The observed meridian altitude of the Sun's Lower Limb was $78^{\circ} 29' 10''$ bearing North, index error $+ 8' 10''$, height of eye 16 feet.

Required the Latitude ?

5. In Latitude $45^{\circ} 42'$, the Departure made good was 94 miles.

Required the Difference of Longitude by parallel sailing ?

The Candidate should sign his name in full at the foot of every page.

6. Required the course and distance from A to B, by calculation on Mercator's principle ?

Lat..... of A. $85^{\circ} 47' N.$

Lat..... of B. $20^{\circ} 28' S.$

Long..... $5^{\circ} 56' W.$

Long..... $28^{\circ} 51' W.$

7. 1880, July 2nd. Find the time of High Water at Bordeaux A.M. and P.M.

8. 1884, July 22nd. At 7h. 34m. P.M. Appt T. Ship in latitude $46^{\circ} 22' N.$, longitude $144^{\circ} W.$ The Sun's Magnetic Amplitude was W. by N.

Required True Amplitude and Error of the Compass ; and supposing the Variation to be $16^{\circ} 30' E.$ Required the Deviation of the Compass for that position of the Ship's head ?

9. 1884, July 23rd, P.M. at Ship, in latitude $38^{\circ} 14' N.$ The observed altitude of the Sun's L.L. was $42^{\circ} 55'$, index error $+ 1' 15''$, height of eye 19 feet. Time by a chronometer 23d 14h. 6m. 10s., which was 2m. 42s. fast for mean noon at Greenwich on January 10th, and on March 18th, was 1m. 16s. slow for mean noon at Greenwich.

Required the Longitude by Chronometer ?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, August 29th. At 5h. 0m. P.M. Mean Time at Ship, in latitude $48^{\circ} 2' N.$ Longitude $40^{\circ} W.$ The Sun's bearing by Compass was W.N.W., the altitude of its L.L. $16^{\circ} 32'$, Height of the Eye 14 feet.

Required the True Azimuth and Error of the Compass ; and supposing the Variation to be $37^{\circ} 30' W.$ Required the Deviation of the Compass for that position of the Ship's head ? Both by the Sun's Altitude and by the Time Azimuth Tables.

11. 1884, August 30th, P.M. at Ship, lat by account $40^{\circ} 46' N.$ Long $142^{\circ} 12' E.$ The observed altitude of the Sun's L.L. South of the observer was $57^{\circ} 24'$, index error— $1' 20''$, height of eye 24 feet. Time by chronometer 30d. 0h. 29m. 24s., which had been found to be 19s. slow of apparent time at Ship.

The difference of longitude made to the West was 31 miles after the error on Apparent Time at Ship was determined.

Required the Latitude by the Reduction to the Meridian ?

ADDITIONAL FOR MASTER.

12. 1884, July 28th. The observed Meridian Altitude of the Star α Canis Majoris (Sirius) bearing South was $54^{\circ} 18' 38''$ Height of the Eye 14 feet.

Required the Latitude ?

The Candidate should sign his name in full at the foot of every page.

EXAMINATION PAPER, NO. VIII.

FOR SECOND MATE.

1. Multiply .042 by 25000, by common logarithms.
2. Divide .007616 by .000642, by common logarithms.
- 8.

Hrs.	Courses.	Knts.	10ths	Winds.	Lee- Way.	Devi- tion.	Remarks, &c.
1	E. $\frac{1}{2}$ N.	1	5	N.N.E.	$\frac{1}{2}$	23° E.	A point in lat. 38° 28' N. Long. 28° 25' W.
2		1	7				
3		1	9				
4		1	9				
5	N. by E. $\frac{1}{2}$ E.	6	7	E.	$\frac{1}{2}$	11° E.	bearing by Compass N.E. $\frac{1}{2}$ E.
6		8	9				
7		8	9				
8		8	9				Dist. 37 miles.
9	S. by E. $\frac{1}{2}$ E.	5	4	E.	$\frac{3}{4}$	3° W	(Ship's head E. $\frac{1}{2}$ N., Deviation as per log.)
10		3	2				
11		2	7				
12		1	7				
1	N.E. $\frac{1}{2}$ N.	2	4	E.S.E.	1	25° E.	Variation 25° West.
2		3	1				
3		3	7				
4		2	8				
5	E.N.E.	2	1	N.	$1\frac{1}{4}$	25° E.	A Current set } W. $\frac{1}{2}$ S. correct magnetic.
6		1	9				
7		1	5				
8		1	5				
9	E. $\frac{1}{2}$ N.	2	6	N. by E.	$1\frac{1}{2}$	23° E.	24 Miles from the time the departure was taken to the end of the day.
10		3	9				
11		4	8				
12		3	7				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

4. 1884, August 29th. In Longitude 64° 20' E. the observed meridian altitude of the Sun's Lower Limb was 89° 57' 20" bearing North index error—1' 20" height of eye 17 feet.

Required the Latitude ?

5. In Latitude 22° 18', the Departure made good was 75 miles.

Required the Difference of Longitude by parallel sailing ?

The Candidate should sign his name in full at the foot of every page.

6. Required the Course and Distance from A to B, by calculation on Mercator's principle.

Lat. of A..... $84^{\circ} 21' S$.

Long..... $18^{\circ} 30' E$.

Lat. of B..... $40^{\circ} 28' N$.

Long..... $78^{\circ} 52' W$.

7. 1880, July 1st. Find the time of High Water at Penzance A.M. and P.M.

8. 1884, August 29th. At 6h. 31m. A.M., Appt T. Ship, in lat $40^{\circ} 10' S$. Longitude $160^{\circ} 20' E$. The Sun's Magnetic Amplitude was East.

Required True Amplitude and Error of the Compass ; and supposing the Variation to be $14^{\circ} 10' E$. Required the Deviation of the Compass for that position of the Ship's head ?

9. 1884, August 31st, P.M. at Ship, in latitude $28^{\circ} 16' S$. The observed altitude of Sun's L.L. was $26^{\circ} 18'$, height of eye 22 feet. Time by a chronometer 81d. 5h. 14m. 16s. which was 1m. 22s. slow for mean noon at Greenwich on March 15th, and on May 22nd was 2m. 36s. fast for mean noon at Greenwich.

Required the Longitude by Chronometer ?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, July 28rd. At 8h. 20m. 49s. P.M., Mean Time at Ship, in latitude $88^{\circ} 14' N$, longitude $165^{\circ} 35' W$. The Sun's bearing by Compass was W by S. $\frac{1}{2}$ S., the altitude of its L.L. $42^{\circ} 55'$, index error $+ 1' 15''$, Height of the Eye 19 feet.

Required the True Azimuth and Error of the Compass ; and supposing the Variation to be $18^{\circ} 40' E$. Required the Deviation of the Compass for that position of the Ship's head ; both by the Sun's altitude, and also by the Time Azimuth Tables.

11. 1884, July 22nd, P.M. at Ship, lat. by account $27^{\circ} 30' S$. long $85^{\circ} 30' W$. The observed altitude of the Sun's L.L. North of the observer was $42^{\circ} 10'$, height of eye 21 feet. Time by watch 21d. 20h. 16m. 5s. which had been found to be 8h. 52m. 12s. slow of apparent time at Ship.

The difference of longitude made to the West was 12 miles after the error on Apparent Time on Ship was determined. Required latitude by the Reduction to the Meridian.

ADDITIONAL FOR MASTER.

12. 1884, August 19th. The observed Meridian Altitude of the Star α^2 Geminorum (Castor), bearing South was $72^{\circ} 14' 10''$, height of the eye 16 feet.

Required the Latitude ?

The Candidate should sign his name in full at the foot of every page.

EXAMINATION PAPER, NO. IX.

FOR SECOND MATE.

1. Multiply 64.2 by 286, by common logarithms.
2. Divide 675.14 by 421, by common logarithms.
- 3.

Hrs.	Courses	Knts.	10ths	Winds.	Lee-way.	Devia-tion	Remarks, &c.
1	S. 51° E.	6	1	S. 22 °W	6°	20° W	A point, Krakatea Peak. in Lat. 6° 9' S. Long. 105 29 E.
2		6	0				
3		5	9				
4		5	0				
5	S. 51° W.	5	6	N. 45 °W.	8°	17° E	bearing by Compass S. 51° W.
6		5	9				
7		6	5				
8		6	0				
9	N. 68° W.	7	4	S. 45 °W.	14°	11° E.	Dist 18 miles. (Ship' head, S. 51° E. Deviation as per log.)
10		8	2				
11		9	9				
12		10	5				
1	S. 68° W.	9	3	S. 23° E.	3°	17° E.	Variation 3° East.
2		8	7				
3		7	2				
4		2	8				
5	S. 84° W.	3	7	S. 23° E.	3°	17° E.	A Current set, } N. 45° W. correct magnetic
6		4	9				
7		5	1				
8		6	3				
9		6	4				
10		5	2				
11		5	3				
12		4	4				
							10 Miles from the time the departure was taken to the end of the day.

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

4. 1884, September 22nd. In Longitude 125° 14' W., the observed meridian altitude of the Sun's Lower Limb was 89° 52' 10" bearing North, index error 0, height of eye 20 feet.

Required the Latitude?

5. In latitude 15° 42', the Departure made good was 117 miles.

Required the Difference of Longitude by parallel Sailing?

6. Required the course and distance from A to B, by calculation on Mercator's principle?

Lat. of A..... $56^{\circ} 25'$ S.
Lat. of B..... $82^{\circ} 48'$ N.

Long. $68^{\circ} 44'$ W.
Long. $129^{\circ} 46'$ E.

7. 1880, July 8th. Find the time of High Water at Christchurch, A.M. and P.M.

8. 1884, September 22nd. At 6h. 0m. P.M., Appt. T. Ship, in latitude $48^{\circ} 16'$ N., longitude 24° W. The Sun's Magnetic Amplitude was W. by N. $\frac{1}{4}$ N.

Required True Amplitude and Error of the Compass; and supposing the Variation to be $85^{\circ} 80'$ W. Required the Deviation of the Compass for that position of the Ship's head?

9. 1884, September 22nd, P.M. at Ship, in latitude $82^{\circ} 16'$ S. The observed altitude of the Sun's L.L. was $82^{\circ} 16' 40''$, index error — $1' 10''$, height of the eye 21 feet. Time by a chronometer 22d. 10h. 32m. 6s., which was 1m. 42s. slow for mean noon at Greenwich on March 14th, and on June 24th was 1m. 42s. fast for mean noon at Greenwich.

Required the Longitude by Chronometer?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, June 14th. At 8h. 28m. 30s. A.M., Mean Time at Ship, in latitude $84^{\circ} 16'$ S., longitude $49^{\circ} 9'$ E. The Sun's bearing by Compass was E. $\frac{1}{4}$ N., the altitude of its L.L. $12^{\circ} 48'$, height of the eye 20 feet.

Required the True Azimuth and Error of the Compass; and supposing the Variation to be $24^{\circ} 10'$ W. Required the Deviation of the Compass for that position of the Ship's head? Both by the Sun's Altitude and by the Time Azimuth Tables.

11. 1884, June 18th, A.M. at Ship, lat. by account $57^{\circ} 38'$ N., long. $9^{\circ} 20'$ W. The observed altitude of the Sun's L.L. South of the observer was $55^{\circ} 21'$, height of eye 17 feet. Time by chronometer 18d. 2h. 17m. 42s., which had been found to be 2h. 39m. 20s. fast of apparent time at Ship.

The difference of longitude made to the East was $51\frac{1}{2}$ miles after the error on Apparent Time at Ship was determined.

Required the Latitude by the Reduction to the Meridian?

ADDITIONAL FOR MASTER.

12. 1884, September 6th. The observed Meridian Altitude of the Star α Canis Minoris (Procyon), bearing North, was $46^{\circ} 19' 40''$, I.E. + $2' 30''$, height of the eye 25 feet.

Required the Latitude?

The Candidate should sign his name in full at the foot of every page.

EXAMINATION PAPER, NO. X.

FOR SECOND MATE.

1. Multiply 87.42 by 547.9, by common logarithms.
2. Divide 782.16 by 469, by common logarithms.
- 3.

Hrs.	Courses.	Knts.	10ths	Winds.	Lee-way.	Devi- tion.	Remarks, &c.
1	W. $\frac{1}{2}$ N.	5	4	N.N.W.	$\frac{1}{2}$	17° E.	A point of land in Lat. 49° 54' N., Long. 6° 21' W.
2		6	4				
3		5	2				
4		6	2				
5	N.E. $\frac{3}{4}$ E.	6	2	N. by W.	1 $\frac{1}{2}$	14° W.	bearing by Compass N. $\frac{1}{2}$ W. Dist. 15 miles.
6		6	1				
7		4	6				
8		4	1				
9	N.W. by N.	2	1	West.	$\frac{1}{2}$	0	(Ship's head W. $\frac{1}{2}$ N., Deviation as per log.)
10		2	9				
11		2	3				
12		3	7				
1		4	0				
2	S.W. by S.	5	8	S.E.	2 $\frac{1}{2}$	25° E.	Variation 25° West.
3		5	6				
4		5	4				
5		5	2				
6	W.S.W.	5	1	S.	1	25° E.	A Current set } S.E. $\frac{1}{4}$ E. correct magnetic }
7		5	2				
8		5	0				
9		6	1				
10	W. by S. $\frac{1}{2}$ S.	7	3	S.	2 $\frac{1}{2}$	25° E.	Dist 30 miles from the time the departure was taken to the end of the day.
11		4	2				
12		3	5				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by inspection.

4. 1884, October 27th. In Longitude 164° 18' E. The observed meridian altitude of the Sun's Lower Limb was 89° 54' 20", bearing South, height of eye 19 feet, index error + 1' 10".

Required the Latitude ?

5. In Latitude 67° 15', the Departure made good was 84 miles.

Required the Difference of Longitude by parallel sailing ?

6. Required the course and distance from A to B, by calculation on Mercator's principle ?

Lat. of A..... 20° 18' S.
Lat. of B..... 80° 50' N.

Long..... 70° 12' W.
Long..... 122° 40' E.

The Candidate should sign his name in full at the foot of every page.

7. 1880, July 2nd. Find the time of High Water, at Navalo A.M. and P.M.

8. 1884, October 25th. At 5h. 27m. P.M., Appt. T. Ship, in latitude $84^{\circ} 0' N.$, Longitude $19^{\circ} W.$ The Sun's Magnetic Amplitude was W. by S.

Required True Amplitude, and Error of the Compass; and supposing the Variation to be $28^{\circ} 16' W.$?

Required the Deviation of the Compass for that position of the Ship's head?

9. 1884, October 27th A.M. at Ship, in Latitude $83^{\circ} 17' S.$ The observed altitude of the Sun's L.L. was $86^{\circ} 18'$, height of eye 16 feet. Time by a chronometer 26d. 16h. 12m. 22s., which was 1m. 28s. slow for mean noon at Greenwich on March 28th, and on July 20th was 6m. 18s. slow for mean noon at Greenwich.

Required the Longitude by Chronometer?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, May 20th. At 7h. 40m. 21s. A.M., Mean Time at Ship, in latitude $58^{\circ} 47' N.$, longitude $175^{\circ} E.$ The Sun's bearing by Compass was E. by S. the altitude of its L.L. $81^{\circ} 20'$, height of the eye 17 feet.

Required the True Azimuth and Error of the Compass; and supposing the Variation to be $16^{\circ} 80' E.$ Required the Deviation of the Compass for that position of the Ship's head? Both by the Sun's Altitude and by the Time Azimuth Tables.

11. 1884, May 19th, P.M. at Ship, in lat. by account $27^{\circ} 6' S.$, long. $115^{\circ} 15' W.$ The observed altitude of the Sun's L.L. North of the observer was $42^{\circ} 16' 20'' I.E. + 2' 15''$, height of eye 18 feet. Time by chronometer 19d. 0h. 30m. 29s., which had been found to be 6m. 42s. fast of apparent time at Ship.

The difference of longitude made to the East was 24 miles after the error on Apparent Time at Ship was determined.

Required the Latitude by Reduction to the Meridian?

ADDITIONAL FOR MASTER.

12. 1884, October 16th. The observed Meridian Altitude of the Star β Geminorum (Pollux) bearing South was $64^{\circ} 18' 10''$, I.E.— $8' 17''$, height of the eye 24 feet.

Required the Latitude?

The Candidate should sign his name in full at the foot of every page.

EXAMINATION PAPER, NO. XI.

FOR SECOND MATE.

1. Multiply 24000 by 32000, by common logarithms.
2. Divide 9600000 by 160, by common logarithms.
- 8.

Hrs.	Courses.	Knts	10ths	Winds.	Lee-way.	Devia-tion.	Remarks, &c.
1	E. $\frac{1}{2}$ S.	8	5	N. N. E.	$\frac{1}{4}$	21° 20' W	A point, in Lat. 12° 14' N., Long. 179° 12' E., bearing by Compass W. $\frac{1}{2}$ N.
2		9	7				
3		9	8				
4		9	4				
5	E. by S. $\frac{1}{4}$ S.	9	3	S. $\frac{1}{2}$ E.	$\frac{1}{4}$	24° 15' W	Dist. $9\frac{1}{4}$ miles.
6		9	2				
7		9	1				
8		9	2				
9	S.S.W. $\frac{1}{4}$ W.	8	4	S. E.	$\frac{3}{4}$	4° E	(Ship's head E. $\frac{1}{4}$ S., Deviation as per log.)
10		5	6				
11		3	2				
12		2	1				
1	N. $\frac{1}{4}$ E.	2	1	E. by N.	1 $\frac{1}{4}$	12° 40' E	Variation 10° 10' E.
2		2	4				
3		3	6				
4		4	7				
5	E. $\frac{3}{4}$ N.	6	7	N. by E.	2 $\frac{1}{4}$	19° W	A current set correct magnetic } S $\frac{1}{4}$ E.
6		8	9				
7		9	4				
8		9	9				
9	E. by N. $\frac{1}{4}$ N.	9	6	North	2	13° 25' W	7 $\frac{1}{2}$ miles during the day.
10		9	8				
11		9	4				
12		9	3				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude, by Inspection.

4. 1884, November 28th. In Longitude 48° 0' W. The observed Meridian Altitude of the Sun's Lower Limb was 89° 56' 10" bearing South, index error + 2' 10", height of eye 15 feet.

Required the Latitude ?

5. In latitude 65° 44', the Departure made good was 72 miles.

Required the Difference of Longitude by parallel sailing ?

The Candidate should sign his name in full at the foot of every page.

6 Required the course and distance from A to B, by calculation on Mercator's principle?

A Lat.....	2° 14' N.	Long.....	81° 16' W.
B Lat.....	1° 42' S.	Long.....	138° 22' E.

7. 1880, July 1st. Find the Time of High Water at Plymouth Breakwater, A.M. and P.M.

8. 1884, November 29th. At 2h. 40m. A.M., Appt. T. at Ship, in latitude $62^{\circ} 14'$ S. longitude 170° E. The Sun's Magnetic Amplitude was S.E. $\frac{1}{4}$ S.

Required the True Amplitude and Error of the Compass; and supposing the Variation to be $25^{\circ} 15'$ E. Required the Deviation of the Compass for that position of the Ship's head?

9. 1884, November 28th, P.M. at Ship, in latitude $42^{\circ} 17'$ N. The observed altitude of the Sun's L.L. was $8^{\circ} 59'$, index error $+4' 10''$, height of eye 19 feet. Time by a chronometer 28d. 5h. 20m. 16s., which was 6m. 14s. fast for mean noon at Greenwich on May 4th, and on September 16th, was 4m. 7s. slow for mean noon at Greenwich.

Required the Longitude by Chronometer?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, April 14th. At 8h. 56m. 26s. A.M., Mean Time at Ship, in latitude $48^{\circ} 14'$ N., longitude $157^{\circ} 31'$ W. The Sun's bearing by Compass was E. by S. $\frac{1}{4}$ S., altitude of its L.L. $35^{\circ} 35' 10''$, I.E. — $1^{\circ} 30'$, height of the eye 17 feet.

Required the True Azimuth and Error of the Compass, and supposing the Variation to be $19^{\circ} 40'$ E. Required the Deviation of the Compass for that position of the Ship's head? Both by the Sun's Altitude and by the Time Azimuth Tables.

11. 1884, April 15, A.M. at Ship, latitude by account $35^{\circ} 38'$ S., longitude 170° E. The observed altitude of the Sun's L.L. North of the observer was $44^{\circ} 18'$, height of eye 14 feet. Time by chronometer 15d. 0h. 18m. 24s., which had been found to be 30m. 16s. fast of apparent time at Ship.

The difference of longitude made to the East was 58 miles after the error on Apparent Time at Ship was determined.

Required the Latitude by the Reduction to the Meridian?

ADDITIONAL FOR MASTER.

12. 1884, November 25th. The observed Meridian Altitude of the Star α Leonis (Regulus) bearing North was $22^{\circ} 18' 10''$, height of the eye 23 feet.

Required the Latitude?

The Candidate should sign his name in full at the foot of every page

EXAMINATION PAPER, NO. XII.

FOR SECOND MATE.

1. Multiply 651.48 by .00000417, by common logarithms.
2. Divide .0000478 by .0000021 by common logarithms.
3. *Note.* Solve 1 and 2 by both common and negative indices.

Hrs.	Courses.	Knts.	10ths	Winds.	Lee-way.	Deviation.	Remarks, &c.
1	S. 79° W.	6	4	N. 34° W.	3°	20° W.	A point of land, Cape Clear, in Lat. 51° 26' N., Long 9° 29' W. bearing by Compass S. 73° E.
2		6	2				
3		6	4				
4		6	0				
5	N. 68° W.	5	6	North.	6°	25° W.	Dist. 15 miles.
6		5	2				
7		5	2				
8		5	0				
9	S. 56° W.	4	2	N. 56° W.	11°	11° W.	(Ship's head S. 79° W., Deviation as per log.)
10		4	6				
11		4	2				
12		4	0				
1	N. 23° W.	4	0	West	17°	14° W.	Variation 28° W.
2		4	0				
3		3	6				
4		3	4				
5	N. 34° W.	3	2	S. 79° W.	23°	20° W.	A current } N. 28° E. set correct } magnetic. }
6		3	4				
7		3	4				
8		3	0				
9	N. 68° W.	2	8	S. 45° W.	25°	25° W.	24 miles from the time the departure was taken to the end of the day.
10		2	2				
11		2	0				
12		2	6				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

4. 1884, December 24th, in Longitude 179° 0' E. The observed Meridian Altitude of the Sun's Lower Limb was 89° 57' 10" bearing North, index error 0, height of the eye 18 feet.

Required the Latitude ?

5. In latitude 1° 31', the Departure made good was 165 miles.

Required the difference of Longitude by parallel sailing ?

The Candidate should sign his name in full at the foot of every page.

6. Required the course and distance from A to B by calculation on Mercator's principle ?

Lat. of A..... $8^{\circ} 18' N.$
 Lat. of B..... $1^{\circ} 7' S.$

Long. A..... $84^{\circ} 25' W.$
 Long. B..... $140^{\circ} 6' E.$

7. 1880, July 8th. Find the Time of High Water at Bembridge Point, A.M. and P.M.

8. 1884, Dec. 22nd. At 11h. 22m. P.M., Appt. T. Ship, in latitude $64^{\circ} 15' S.$, longitude $96^{\circ} W.$ The Sun's Magnetic Amplitude was $S. \frac{1}{4} E.$

Required True Amplitude and Error of the Compass; and supposing the Variation to be $32^{\circ} 0' E.$ Required the Deviation of the Compass for that position of the Ship's head ?

9. 1884, December 24th, A.M. at Ship, in latitude $38^{\circ} 14' S.$ The observed Altitude of the Sun's L.L. was $43^{\circ} 56'$, height of eye 23 feet. Time by a Chronometer 23d. 15h. 16m. 4s., which was 2m. 10s. slow for mean noon at Greenwich, July 10th, and on October 16th was 1m. 55s. fast for mean noon at Greenwich.

Required the Longitude by Chronometer ?

ADDITIONAL FOR ONLY AND FIRST MATE.

10. 1884, March 19th. At 4h. 5m. 42s. P.M., Mean Time at Ship, in latitude $32^{\circ} 4' N.$, longitude $178^{\circ} W.$ The Sun's bearing by Compass was $W. by S. \frac{1}{4} S.$, the altitude of its L.L. $25^{\circ} 15' 40''$, height of the eye 19 feet.

Required the True Azimuth and Error of the Compass; and supposing the Variation to be $12^{\circ} 10' E.$ Required the Deviation of the Compass for that position of the Ship's head ? Both from the Altitude and also from the Azimuth Tables.

11. 1884, March 20th, A.M. at Ship, latitude by account $37^{\circ} 57' N.$, long. $178^{\circ} E.$ The observed Altitude of the Sun's L.L. South of the observer was $51^{\circ} 16' 15''$, index error — $1' 15''$, height of eye 19 feet. Time by watch 19d. 23h. 32m. 2s., which had been found to be 2m. 4s. fast of Apparent Time at Ship.

The difference of Longitude made to the East was 38 miles after the error on Apparent Time at Ship was determined.

Required the Latitude by Reduction to the Meridian.

ADDITIONAL FOR MASTER.

12. 1884, December 17th. The observed Meridian Altitude of the Star α Virginis (Spica) bearing South was $68^{\circ} 18' 10''$, height of the eye 22 feet.

Required the Latitude ?

The Candidate should sign his name in full at the foot of every page.

ANSWERS TO PAPER I.

No. Question.

1. Multiplication, Log. 5·871481. Product 285196·74.
2. Division Log. 0·425060. Quotient 2·661.
3. Day's Work } S 32° W 18; S 16° W 29; S 2° W 24; S 30° E 24;
 True Courses } S 33° E 25; S 73° W 21; N 71° W 17; S 25° W 25;
 Diff. lat. 132·3 S. Dep. 39·5 W. Lat. in. 36° 33' S
 Long. in 114° 17½' E. Course S 16½° W. Dist. 137½ mls.
 By logs. Diff. long. 48·49. Course S 16° 37' W. Dist.
 138·1 mls.
4. Meridian } ... A.T.G. 3d 1h 43m 20s. Red. dec. 22° 50' 58" S.
 Altitude } ... True alt. 52° 31' 17" S. Latitude 14° 37' 45" N.
5. Parallel } ... Log. 2·236391. Diff. long. 172·3
 Sailing }
6. Mercator } ... Diff. lat. 104 S. Mer. Diff. lat. 162 Diff. long. 185 W.
 Sailing } ... Tan. 10·057657. Log. dist. 2·198352.
 Course S 48° 48' W. Distance 157·9 mls.
 To seconds of arc. Course S 48° 47' 32" W. Distance 157·9. mls.
7. Tides..... Constant—0h 29m. 11h 35m A.M. No P.M. tide.
8. Amplitude ... A.T.G. 1d 20h 43m 4s. Red. dec. 22° 57' 38" S.
 Sin. 9·720209. True amp. E 31° 40' S.
 Error 35° 50' W. Deviation 12° 0' W.
 To seconds of arc. Deviation 12° 0' 12" W.
9. Chronometer...Daily rate 1s gaining.
 M.T.G. 2d 5h 11m 11s. P.D. 67° 4' 14"
 Eq. T. + 4m 12·67s. True alt. 41° 56' 43"
 Log. 9·305070. H.A. 3h 33m 35s.
 Longitude 23° 20' 45" West.
10. AzimuthM.T.G. 7d 20h 16m 13s. P.D. 74° 52' 26".
 True alt. 41° 5' 4". Sin. 9·798478.
 True az. 77° 55' East. Error 9° 16' W.
 Deviation 18° 14' East. To seconds of arc 18° 14' 35" E.
 By Azimuth Tables, Deviation 18° 27' East.
11. Reduction.....A.T.G. 8d 0h 48m 54s. T. from N. 24m 34s
 Red. dec. 15° 8' 50". True alt. 59° 15' 41".
 Log. 3·728668. Lat. 15° 4' N.
 To seconds of arc 15° 4' 9" N.
12. StarTrue alt. 47° 47' 45" N. Lat. 62° 20' 10" N.

ANSWERS TO PAPER II.

No. Question.

1. Multiplication. Log. 8.982640. Product 8568.27.
2. Division.Log. 1.452778. Quotient 28.86.
3. Day's Work } S 63° W, 17; S 36° E, 21; S 52° E, 29; S 76° E, 24;
True Courses } N 85° E, 14; S 74° W, 12; N 72° W, 28; S 14 E, 34.
Diff. lat. 74.8 S. Dep. 27.4 E. Lat. in 49° 9' N.
Long. in 178° 32' W. Course S 20° E. Dist. 80 miles.
By logs D. Long. 42.42. Course S 20° 7' E. Distance
79.66 miles.
4. Meridian }A.T.G. 8d 16h 88m 4s. Red. dec. 14° 51' 19" S.
Altitude. }True alt. 61° 24' 46" N. Lat. 49° 26' 38" S.
5. Parallel }Log. 2.444776. Diff. Long. 278.5
Sailing. }
6. Mercator }Diff. lat. 157° N. Mer. diff. lat. 284°.
Sailing }Diff. long. 728° E.
Tan. 10.408818. Log dist. 2.635869.
Course N 68° 41' E. Distance 481.9 miles.
To seconds of arc Course 68° 41' 19". Dist. 482.
7. Tides.....Constant — 0h 2m. 11h 45m A.M. No P.M.
8. Amplitude. ...A.T.G. 8d 2h 81m. Red. dec. 15° 2' 30" S.
Sin. 9.782278. True amp. W 82° 40' S.
Error 25° 10' W. Deviation 20° 8' E.
To seconds of arc, Deviation 20° 8' 47" E.
9. Chronometer...Daily rate 1.82s Losing.
M.T.G. 7d 20h 16m 14s. P.D. 74° 52' 26".
Eq. T. + 14m 23.72s. True alt. 41° 5' 4".
Log 9.248256. H.A. 20h 40m 54s.
Longitude 9° 46' East.
10. AzimuthM.T.G. 2d 5h 11m 12s. P.D. 67° 4' 14".
True alt. 41° 56' 43". Sin. 9.824570.
True az. N 88° 47' W. Error 16° 17' W.
Deviation 10° 47' W. By Azimuth Tables 11° 8' W.
Working to seconds of arc, Dev. 10° 44' 44" W.
11. Reduction.....A.T.G. 2d 1h 0m 30s. Time from noon 12m 22s.
Red. dec. 22° 56' 41" S. True alt. 59° 29' 51" S.
Log 3.123611. Nat. num. 1329.
Mer. Zen. dist. 30° 21' N. Lat. 7° 24' N.
To Seconds of arc, Lat. 7° 24' 27" N.
12. StarTrue alt. 82° 12' 41" S. Lat. 0° 2' 30" S.

ANSWERS TO PAPER III.

No. Question

1. Multiplication. Log. 9·429429. Product 2688000000.
2. Division.....Log. 2·141740. Quotient 188·59.
8. Day's Work } N 18° E, 17; S 82° E, 20; S 85° E, 18; S 52° E, 21;
 True Courses } N 24° E, 27; N 11° W, 19; N 49° W, 22; N 14° E, 9;
 Diff. lat. 65·4 N. Dep. 52·5 E. Lat. in 55° 12' N.
 Long. in 1° 25½' E. Course N 89° E. Dist. 83½ miles.
 By Logs. Diff. long. 90·74. Course 88° 45'. Dist. 83·86.
 miles.
4. Meridian }A.T.G. 19d. 14h. 8m. 0s. Red. dec. 0° 2' 28" S.
 Altitude }True alt. 51° 24' 27" S. Lat. 38° 38' 5" N.
5. Parallel }Log. 2·386041. Diff. long. 243·2.
 Sailing }
6. Mercator's } ...Diff. lat. 53° S. Mer. diff. lat. 8·2. Diff. long. 0° 47' E.
 Sailing } ...Tan. 9·758284. Log dist. 1·785946.
 Course S. 29° 49' E. Distance 61·09 miles.
 To Seconds of Arc, Course S. 29° 49' 12" E. Dist. 61·09
 miles.
7. Tides.....Constant + 0h. 4m. 0h. 11m. P.M. No A.M.
8. Amplitude.....A.T.G. 19d. 16h. 22m. 12s. Red. dec. 0° 0' 12" S.
 True amp. E. 0° 0'. Error 2° 49' E.
 Deviation 13° 29' E.
9. Chronometer...Daily rate 1·5s. gaining
 M.T.G. 19d. 15h. 37m. 59s. P.D. 90° 1' 6".
 Eq. T. + 7m. 31·19s. True alt. 25° 25' 34".
 Log 9·391953. H.A. 3h. 58m. 11s.
 Longitude 173° 4' 15" West.
10. AzimuthM.T.G. 23d. 15h. 11m. 9s. P.D. 66° 34' 38"
 True alt. 44° 6' 41". Sin. 9·836281.
 True az. S. 93° 24' E. Error 20° 16' W.
 Deviation 0° 6' W. By Azimuth Tables 0° 26' W.
 To Seconds of Arc. Deviation 0° 5' 16" W.
11. Reduction ...A.T.G. 23d. 2h. 47m. 58s. T. from N. 27m. 80s.
 Red. dec. 23° 25' 56" S. True alt. 59° 10' 25" N.
 Log 3·590492. Nat. num. 8895 Lat. 53° 50' S.
 To Seconds of Arc. Lat 53° 49' 13" S.
12. StarTrue alt. 52° 5' 31" N. Lat 21° 38' 6" S.

ANSWERS TO PAPER IV.

- No. Question.*
1. Multiplication. Log 4·667470. Product 46501·83.
 2. DivisionLog 1·876449. Quotient 28·79.
 8. Day's Work } S 16° W, 21; S 49° E, 56; S 59° E, 61; S 48° E, 69;
 True Courses } S 87° E, 68; S 27° E, 25; N 38° W, 5; N 20° W, 23;
 Diff. lat. 139·2 S. Dep. 204·1 E. Lat. in 50° 3' S.
 Long. in 175° 49' W. Course S 55½ E. Dist. 248 miles.
 By logs. Diff. long. 310·4. Course 55° 42'. Dist. 247 miles.
 4. Meridian }A.T.G. 18d 17h 53m 12s. Red. dec. 9° 33' 56" N.
 Altitude. }True alt. 90° 6' 34" S. Latitude 9° 27' 22" N.
 5. Parallel }Log. 2·713078. Diff. Long. 516·5.
 Sailing }
 6. Mercator's } ...Diff. lat. 1244 N. M.D.L. 2662. Diff. Long. 1724 E.
 Sailing } ...Tan. 9·811329. Log. Dist. 3·170901.
 Course N 32° 56' E. Distance 1482 miles.
 To seconds of arc, Course 32° 55' 42". Dist. 1482 miles.
 7. Tides.....Constant — 0h 46m, 11h 18m A.M. 11h 53m P.M.
 8. Amplitude.....A.T.G. 14d 19h 17m 40s. Red. dec. 9° 56' 38" N.
 Sin. 9·528209. True amp. W 19° 43' N.
 Deviation 8° 46' W. To seconds 8° 46' 12" W.
 9. Chronometer...Daily rate 4·8s gaining.
 M.T.G. 14d 11h 26m 51s. P.D. 80° 10' 24".
 Eq. T. + 0m 0·02s. True alt. 35° 44' 20".
 Log. 9·181655. H.A. 3h 3m 84s.
 Longitude 125° 49' 15" West.
 10. AzimuthM.T.G. 28d 5h 30m 1s. P.D. 111° 28' 57"
 True alt. 9° 9' 28". Sin. 9·622699.
 True az. S 49° 36' W. Error 1° 47' E.
 Dev. 13° 7' E. By Azimuth Tables Dev. 13° 32' E.
 To seconds of arc, Dev. 13° 7' 49" E.
 11. ReductionA.T.G. 29d 1h 48m 28s. T. from N. 35m 32s.
 Red. dec. 21° 37' 19" S. True alt. 56° 21' 38" N.
 Log 3·810356. Nat. num. 6462.
 Lat. 54° 35' S. To seconds, Lat. 54° 35' 14" S.
 12. StarTrue alt. 29° 8' 36". Lat. 14° 58' 44" South.

ANSWERS TO PAPER V.

No. *Question.*

1. Multiplication. Log. 8·977909 Product. 9504·07.
2. DivisionLog. 9·100514. Quotient ·126.
3. Day's Work } S 76° E, 20; N 12° E, 48·8; N 14° W, 29·8; N 27° W, 14·9
 True Courses } S 86° E, 44·2; S 70° E, 15·2; S 49° E, 22·1; N 19 E, 16.
 Diff. lat. 76·9 N. Dep. 95·7 E. Lat. in 58° 59' N.
 Long. in 1° 0' E. Course N 51° E. Dist. 128 miles.
 By Logs Diff. Long. 182·8. Course 51° 13'. Dist. 122·8.
4. Meridian }A.T.G. 20d 12h 17m 4s. Red. dec. 20° 18' 37" N.
 Altitude. }True alt. 54° 28' 56" S. Lat. 55° 44' 41" N.
5. Parallel }Log. 2·998496. Diff. Long. 985·1.
 Sailing. }
6. Mercator's } ...Diff. lat. 201 S. M.D.L. 265. Diff. Long. 8779 W.
 Sailing. } ...Tan. 11·154181. Log dist. 8·457809.
 Course S 85° 59' W. Distance 2870 miles.
 To seconds 85° 59' 19". Dist. 2878 miles.
7. Tides.....Constant + 0h 50m., 0h 2m A.M. 0h 37m P.M.
8. Amplitude.....A.T.G. 20d 8h 45m 4s. Red. dec. 20° 9' 15" N.
 Sin. 9·697281. True amp. E 29° 52' N.
 Error 8° 58' E. Deviation 8° 52' West.
 To seconds of arc, Deviation 8° 52' 28" West.
9. Chronometer...Daily rate 2·63 Losing.
 M.T.G. 20d 5h 13m 8s. P.D. 110° 10' 0".
 Eq. T. — 8m 40·08s. True alt. 24° 21' 46".
 Log 9·287852. H.A. 3h 28m 57s.
 M.T.S. 20d 8h 25m 17s.
 Longitude 26° 57' 45" West.
10. AzimuthM.T.G. 26d 16h 22m 42s. P.D. 77° 4' 45".
 True alt. 86° 24' 1". Sin. 9·818741.
 True az. S 98° 44' E. Error 22° 48' W.
 Deviation 1° 32' E. To seconds of arc 1° 32' 29" E.
 By Azimuth Tables 1° 52' E.
11. Reduction.....A.T.G. 25d 1h 84m 40s. T. from N. 2m. 24s.
 Red. dec. 12° 22' S. True alt. 48° 2' 45".
 Log 1·668078. Nat num. 47.
 Lat. 29° 35' N. To seconds of arc 29° 35' 1" N.
12. StarTrue alt. 64° 22' 25" S. Lat. 17° 17' 12" N.

ANSWERS TO PAPER VI.

- No. *Question.*
1. Multiplication. Log 4·666416, 6·666416. Product ·000004689.
 2. Division.....Log 2·892228. Quotient 780·28.
 3. Day's Work } N 11° W, 22; S 88° W, 18; S 56° W, 15; S 44° E, 17·9;
 True Courses } N 81° W, 38; N 71° W, 81; N 63° W, 21; S 53 W, 20.
 Diff. lat. 51·9 N. Dep. 150·5 W. Lat. in 18° 84' S.
 Longitude in 182° 12' W. Course N 71° W. Dist. 159 miles.
 By Logs Diff. Long. 155·1. Course 70° 58'. Dist. 159·1.
 4. Meridian }A.T.G. 18d 12h 14m 4s. Red. dec. 23° 16' 57" N.
 Altitude }True alt. 90° 8' 28" N. Lat. 28° 25' 25" N.
 5. Parallel }Log 8·506082. Diff. Long. 8207.
 Sailing }
 6. Mercator's } ...D. Lat. 4402 S. M.D.L. 4788. D. Long. 2865 W.
 Sailing } ...Tan. 9·781580. Log dist. 8·711846
 Course S 81° 10' W. Distance 5145 miles.
 To seconds of arc, Course 81° 9' 89". Dist. 5144.
 7. Tides.....Constant — 2h 31m. 9h 36m A.M. 9h 54m P.M.
 8. Amplitude.....A.T.G. 12d 12h 38m 20s. Red. dec. 28° 18' 54" N.
 Sin. 9·987844. True amp. E 76° 30' N.
 Deviation 80° 56' E. To seconds 80° 56' 48" E.
 9. Chronometer...Daily rate 3s gaining.
 M.T.G. 18d 17h 6m 54s. P.D. 118° 17' 80".
 Eq. T. — 0m 0·40s. True alt. 12° 50' 20".
 Log 9·815988. H.A. 20h 23m 80s.
 M.T.S. 18d 20h 28m 80s.
 Longitude 49° 9' East.
 10. Azimuth.M.T.G. 22d 10h 27m 20s. P.D. 89° 53' 2".
 True alt. 82° 25' 84". Sin. 9·789295.
 True az. 66° 38' W. Error 8° 46' E.
 Deviation 8° 44' W. By Azimuth Tables Dev. 8° 47' W.
 By working to seconds of arc. Dev. 8° 48' 9" W.
 11. Reduction.....A.T.G. 22d 11h 42m 19s. T. from N. 20m 19s.
 Red. dec. 0° 8' 1" S. True alt. 44° 55' 33" S.
 Log 8·445516. Nat. num. 2789.
 M.Z.D. 44° 50' N. Lat. 44° 42' N.
 To seconds of arc, Lat. 44° 42' 52" N.
 12. StarTrue alt. 78° 39' 48" S. Lat. 41° 17' 56" S,

ANSWERS TO PAPER VII.

No. Question.

1. Multiplication. Log 9·177825, 1·177825. Product ·1504.
2. Division.....Log 7·495207. Quotient ·008128.
3. Day's Work } S 65° E, 24; S 82° E, 84·8; S 45° E, 86·1; S 50° E, 84·8
 True Courses. } S 89° E, 84·6; N 89° E, 85·2; N 89° E, 86·2; S 84° E, 18
 Diff. lat. 68·8 S. Dep. 232·0 E. Lat. in 33° 22' S.
 Long. in 177° 11' W.. Course S 75° E. Dist. 241 miles.
 By logs. D. Long. 276·1. Course 74° 37'. Dist. 240·5.
4. Meridian }A.T.G. 22d 1h 53m 4s. Red. dec. 20° 8' 84" N.
 Altitude. }True alt. 78° 43' 55" N. Lat. 3° 52' 29" N.
5. Parallel }Log. 2·129014. Diff. Long. 184·6 miles.
 Sailing. }
6. Mercator's } ...D. Lat. 8875 S. M.D.L. 8557. D. Long. 1875 W.
 Sailing. } ...Tan. 9·587219. Log dist. 9·558512.
 Course S 21° 8' W. Dist. 8618 miles.
 To seconds 21° 8' 5". Dist. 8618.
7. Tides.....Constant + 3h 8m. 2h 15m A.M. 2h 50m P.M.
8. Amplitude.....A.T.G. 22d 17h 10m 0s. Red. dec. 20° 0' 44" N.
 Sin. 9·695524. True amp. W 29° 44' N.
 Error 18° 29' E. Deviation 1° 59' E.
 To seconds of arc, 1° 58' 55" East.
9. Chronometer...Daily rate 3·5s. losing.
 M.T.G. 23d 14h 14m 53s. P.D. 70° 10' 10".
 Eq. T. + 6m 14·17s. True alt. 43° 6' 49".
 Log 9·254299. H.A. 8h 20m 35s.
 M.T.G. 23d 8h 26m 49s.
 Longitude 162° 1' West.
10. AzimuthM.T.G. 29d 7h 40m 0s. P.D. 80° 59' 4".
 True alt. 16° 41' 7". Sin. 9·829847.
 True az. N. 95° 5' W. Error 27° 35' W.
 Deviation 9° 55' E. To seconds 9° 54' 54" E.
 By Azimuth Tables 9° 54' E.
11. Reduction.....A.T.G. 29d 14h 58m 51s. T. from N. 27m 39s.
 Red. dec. 8° 54' 28". True alt. 57° 33' 12" S.
 Log. 8·785540. Nat. num. 5489.
 Mer. Z.D. 57° 33' N. Lat. 40° 46' N.
 To seconds of arc, Lat. 40° 46' 4" N.
12. StarTrue alt. 54° 14' 8" S, Lat. 19° 12' 17" N,

ANSWERS TO PAPER VIII.

No. Question.

1. Multiplication. Log 8·021189. Product 1050.
2. Division.Log 8·925808, 2·925808. Quotient ·0848.
3. Day's Work } S. 49° W, 87; N 85° E, 7; N 8° W, 88·4; S 86° E, 18;
 True Courses. } N 28° E, 12; N 82° E, 7; S 81° E, 15; S 59° W, 24.
 Diff. lat. 8·9 S. Dep. 8·4 W. Lat. in 38° 24' N.
 Long. in 28° 36' W. Course S 65° W. Dist. 9 miles.
 By logs. Diff. Long. 10·72. Course 65° 5'. Dist. 9·268.
4. Meridian }A.T.G. 28d 19h 42m 40s. Red. dec. 9° 11' 40" N.
 Altitude. }True alt. 90° 7' 49". Lat. 9° 19' 29" N.
5. Parallel }Log 1·908821. Diff. long. 81·06.
 Sailing. }
6. Mercator's } ...D. Lat. 4489 N. M.D.L. 4856. D. Long. 5542 W.
 Sailing. } ...Tan. 10·057888. Log dist. 8·888181.
 Course N. 48° 46' W. Distance 6811 miles.
 To seconds, Course 48° 46' 28". Dist. 6812.
7. Tides.....Constant — 1h 18m. 10h 51m A.M. 11h 26m P.M.
8. Amplitude.....A.T.G. 28d 7h 49m 40s. Red. dec. 9° 22' 17" N.
 Sin. 9·828885. True amp. E 12° 18' N.
 Error 12° 18' W. Deviation 26° 28' W.
 To seconds of arc, Deviation 26° 28' 11" W.
9. Chronometer...M.T.G. 81d 5h 5m 46s. P.D. 98° 20' 1"
 Eq. T. — 0m 2·55s. True alt. 26° 27' 28"
 Log 9·811789. H.A. 8h 35m 22s.
 M.T.S. 81d 8h 35m 19s.
 Longitude 22° 36' 45" West.
10. AzimuthM.T.G. 28d 14h 23m 9s. P.D. 70° 10' 16"
 True alt. 48° 6' 49". Sin. 9·815098.
 True az. S 81° 35' W. Error 5° 39' E.
 Deviation 8° 1' W. By Azimuth Tables 8° 25' W.
 To seconds of arc 8° 0' 7" W.
11. Reduction.....A.T.G. 22d 2h 29m 29s. T. from N. 7m 29s.
 Red. dec. 20° 8' 16" N. True alt. 42° 20' 18" N.
 Log 2·647296. Nat. num. 444.
 M.Z.D. 47° 38' S. Latitude 27° 30' S.
 To seconds of arc, Lat. 27° 29' 22" S.
12. StarTrue alt. 72° 9' 55" S. Latitude 49° 58' 22" N.

ANSWERS TO PAPER IX.

No. Question.

1. Multiplication. Log 4·180447. Product 15151·18.
2. Division.Log 0·205112. Quotient 1·604.
8. Day's Work } N 84° E, 18 ; S 74° E, 23 ; S 68° W, 24 ; N 40° W, 36 ;
 True Courses } N 89° W, 28 ; N 78° W, 41·8 ; N 42° W, 10 ;
 Diff. lat. 45·8 N. Dep. 86·5 W. Lat. in 5° 24' S.
 Long. in 104° 2' E. Course N 62° W. Dist. 97½ miles.
 By logs. Diff. long. 86·94. Course 62° 22'. Dist. 97·67.
4. Meridian }A.T.G. 22d 8h 20m 56s. Red. dec. 0° 4' 22" S.
 Altitude }True alt. 90° 8' 45" N. Lat. 0° 0' 57" S.
5. Parallel }Log 2·084699. Diff. long. 121·5.
 Sailing }
6. Mercator's } ...D. Lat. 5848 N. M.D.L. 6198. D. Log 9690 W.
 Sailing } ...Tan. 10·194072. Log dist. 8·996787.
 Course N 57° 24' W. Distance 9926 miles.
 To Seconds of Arc, Course 57° 23' 45". Dist. 9925.
7. Tides.....Constant— 2h 41m. 9h 26m A.M. 9h 44m P.M.
8. Amplitude.....A.T.G. 22d 7h 36m 0s. Red. dec. 0° 4' 1" S.
 Sin. 7·242581. True amp. W 0° 6' S.
 Error 16° 59' W. Deviation 18° 31' E.
 To Seconds of Arc, Deviation 18° 31' 28" E.
9. Chronometer...Daily Rate 2s. gaining.
 M.T.G. 22d 10h 27d 28s. P.D. 89° 53' 2".
 Eq. T.—7m 39·52s. True alt. 32° 25' 38".
 Log 9·263808. H.A. 8h 22m 57s.
 M.T.S. 22d 8h 15m 17s. Long. 108° 1' 30" W.
10. AzimuthM.T.G. 13d 17h 6m 54s. P.D. 113° 17' 30".
 True alt. 12° 50' 20". Sin. 9·628982.
 True az. 49° 45' W. Error 31° 49' W.
 Dev. 7° 39' W. By Azimuth Tables 7° 28' W.
 To Seconds of Arc, Dev. 7° 38' 18" W.
11. Reduction.....A.T.G. 13d 0h 19m 8s. T. from N. 18m 12s.
 Red. dec. 28° 15' 25" N. True alt. 55° 32' 8" S.
 Log 8·191448. Nat. num. 1554.
 M.Z.D. 34° 19' N. Lat. 57° 34' N.
 To Seconds of Arc, Lat. 57° 33' 49" N.
12. StarTrue alt. 46° 16' 20" N. Lat. 38° 12' 32" S.

ANSWERS TO PAPER X.

No. Question.

1. Multiplication. Log 4·811805. Product 20502·42.
2. Division.....Log 0·198492. Quotient 1·561.
3. Day's Work } S 14° E, 15; S 79° W, 23·2; N 29° E, 21; N 58° W, 15;
 True Courses. } S 62° W, 22; S 79° W, 21·4; N 82° W, 15; S 76° E, 80.
 Diff. lat. 11·2 S. Dep. 47·1 W. Lat. in 49° 48' N.
 Long. in 7° 84' W. Course S 77° W. Dist. 49 miles.
 By Logs. D. Long. 72·97. Course 76° 88'. Dist. 48·45.
4. Meridian }A.T.G. 26d 18h 8m 8s. Red. dec. 12° 52' 14" S.
 Altitude. }True alt. 90° 7' 21" S. Latitude 12° 59' 35" S.
5. Parallel }Log 2·886898. Diff. Long. 217·2.
 Sailing. }
6. Mercator's } ...D. Lat. 8068 N. M.D.L. 8185. D.L. 10028 W.
 Sailing. } ...Tan. 10·498105. Log dist. 4·005210.
 Course N 72° 28' W. Distance 10121 miles.
 To seconds of arc, Course 72° 22' 47". Dist. 10119.
7. Tides.....Constant — 0h 5m. 11h 42m A.M. No. P.M. .
8. Amplitude.....A.T.G. 25d 6h 48m 0s. Red. dec. 12° 26' 28" S.
 Sin. 9·914477. True amp. W 15° 8' S.
 Error 8° 48' W. Deviation 19° 28' E.
 To seconds of arc, Dev. 19° 27' 28" E.
9. Chronometer...Daily rate 2·5s losing.
 M.T.G. 26d 16h 22m 42s. P.D. 77° 4' 45".
 Eq. T. — 16m 2·66s. True alt. 86° 24' 1".
 Log 9·824588. H.A. 20h 21m 9s.
 Longitude 55° 36' East.
10. AzimuthM.T.G. 19d 8h 0m 21s. P.D. 70° 0' 55".
 True alt. 81° 30' 19". Sin. 9·812037.
 True az. S 80° 58'. Error 2° 8' W.
 Deviation 18° 38' W. By Azimuth Tables Dev. 18° 57' W.
 To seconds of arc, Dev. 18° 37' 50" W.
11. Reduction.....A.T.G. 19d 8h 6m 28s. T. from N. 25m 28s.
 Red. dec. 19° 59' 6" N. True alt. 42° 29' 17".
 Log 8·709666. Nat. num. 5125.
 M.Z.D. 47° 7' S. Latitude 27° 8' S.
 To seconds of arc, Latitude 27° 7' 39" S.
12. StarTrue alt. 64° 9' 36" S. Lat. 54° 8' 25" N.

ANSWERS TO PAPER XI.

No. Question.

1. Multiplication. Log 8·885361. Product 768 000 000.
2. DivisionLog 4·778151. Quotient 60 000.
3. Day's Work } N 84° E, 9·8 ; N 87° E, 37·4 ; N 87° E, 36·8 ; S 51° W, 19·8.
 True Courses. } N 14° E, 12·8 ; S 82° E, 34·9 ; S 88° E, 38·1 ; S 7° W, 7·8.
 Diff. lat. 8·8 S. Dep. 143·3 E. Lat. in 12° 5' N.
 Long. in 178° 21' W. Course S 86½° E. Dist. 144 miles.
 By Logs. D. Long. 146·6. Course 86° 29'. Dist. 143·5.
4. Meridian }A.T.G. 28d 3h 12m 0s. Red. dec. 21° 27' 53" S.
 Altitude. }True alt. 90° 10' 46" S. Lat. 21° 38' 39" S.
5. Parallel }Log 2·248507. Diff. long. 175·2.
 Sailing. }
6. Mercator's } ...D. Lat. 236 S. M.D.L. 236. D.L. 8422 W.
 Sailing. } ...Tan. 11·552508. Log dist. 3·926971.
 Course S 88° 24' W. Distance 8452 miles.
 To seconds of arc, Course 88° 23' 42". Dist. 8426.
7. Tides.....Constant — 0h 6m. 11h 58m A.M. No. P.M.
8. Amplitude.....A.T.G. 28d 3h 20m 0s. Red. dec. 21° 27' 56" S.
 Sin. 9·895166. True amp. E 51° 56' S.
 Error 1° 8' E. Deviation 24° 7' West.
 To seconds of arc, Dev. 24° 6' 30" West.
9. Chronometer...Daily rate 4·6s Losing.
 M.T.G. 28d 5h 30m 0s. P.D. 111° 28' 57".
 Eq. T. — 11m 34·39s. True alt. 9° 9' 27".
 Log 9·812730. H.A. 8h 35m 38s.
 M.T.S. 28d 3h 24m 4s. Long 81° 29' W.
10. AzimuthM.T.G. 14d 7h 26m 30s. P.D. 80° 13' 59".
 True alt. 85° 44' 20". Sin. 9·702469.
 True az. S 60° 32' E. Error 15° 24' E.
 Dev. 4° 16' W. By Azimuth Tables 4° 45' W.
 To seconds of arc, Dev. 4° 15' 25" W.
11. Reduction.....A.T.G. 14d 12h 30m 0s. T. from Noon 10m 0s.
 Red. dec. 9° 50' 35" N. True alt. 44° 24' 53" N.
 Log 2·882058. Nat. num. 762.
 M.Z.D. 45° 31' S. Latitude 85° 40' S.
 To seconds of arc, Lat. 85° 40' 52" S.
12. StarTrue alt. 22° 11' 6" N. Latitude 55° 17' 15" South.

ANSWERS TO PAPER XII.

No. Question.

1. Multiplication. Log 7·434004, or Log 3·434004. Product ·002716.
2. Division.....Log 1·352642. Quotient 22·52.
8. Day's Work } S 59° W, 15; S 28° W, 25; S 53° W, 21; S 6° W, 17;
 True Courses. } N 48° W, 15; N 59° W, 13; S 84° W, 9·6; North 24.
 Diff. lat. 19° 6' S. Dep. 75·0 W. Lat. in 51° 6' N.
 Long. in 11° 28' W. Course S 75° W. Dist. 77 miles.
 By logs. Diff. long. 119·9. Course 75° 21'. Dist. 77·5.
4. Meridian }A.T.G. 23d 12h 4m 0s. Red. dec. 23° 25' 38" S.
 Altitude. }True alt. 90° 9' 17" N. Lat. 23° 18' 16" S.
5. Parallel }Log 2·217686. Diff. Long. 165·1.
 Sailing. }
6. Mercator's } ...D. Lat. 265 S. M.D.L. 265. D. Long. 8129 W.
 Sailing. } ...Tan. 11·486791. Log dist. 8·910879.
 Course S 88° 8' W. Distance 8135 miles.
 To seconds of arc, Course 88° 7' 58". Dist. 8133.
7. Tides.....Constant 0h 41m. 11h 26m A.M. 11h 44m P.M.
8. Amplitude.....A.T.G. 22d 17h 46m 0s. Red. dec. 23° 26' 18" S.
 Sin. 9·961601. True amp. E 118° 44' S.
 Error 26° 33' E. Deviation 5° 27' W.
 To seconds of arc, Dev. 5° 28' 24" W.
9. Chronometer...Daily rate 2·5s Gaining.
 M.T.G. 23d 15h 11m 17s. P.D. 66° 34' 38".
 Eq. T. — Om 4·06s. True alt. 44° 6' 41".
 Log 9·273697. H.A. 20h 34m 33s.
 M.T.S. 23d 20h 34m 29s. Long. 80° 48' East.
10. AzimuthM.T.G. 19d 15h 37m 42s. P.D. 90° 1' 6".
 True alt. 25° 25' 34". Sin. 9·772658.
 True az. S 72° 40' W. Error 0° 28' W.
 Dev. 12° 38' W. By Azimuth Tables 12° 38' W.
 To seconds of arc, Dev. 12° 38' 38" West.
11. Reduction.....19d 11h 40m 30s. T. from Noon 27m 30s.
 Red. dec. 0° 4' 51" S. True alt. 51° 26' 7" S.
 Log 8·753578. Nat. num. 5670.
 M.Z.D. 38° 2' N. Latitude 37° 57' N.
 To seconds of arc, 37° 57' 35" N.
12. Star True alt. 68° 18' 10" S. Lat. 11° 18' 18" N.

EXAMPLES IN THE USE OF NAPIER'S DIAGRAM.

EXAMPLE I.

7. In the following Table give the correct magnetic bearing of the distant object, and thence the deviation.

Ship's Head by Standard Compass.	Bearing of Distant Object by Standard Compass.	Deviation Required.	Ship's Head by Standard Compass.	Bearing of Distant Object by Standard Compass.	Deviation Required.
North	N 41° E	4° E	South	N 47° E	2° W
N.E.	N 54 E	9 W	S.W.	N 42 E	8 E
East	N 58 E	18 W	West	N 35 E	10 E
S.E.	N 51 E	6 W	N.W.	N 32 E	18 E

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Correct Magnetic Bearing...N 45 E.

In this question the bearings are all in one quadrant of the Compass, they must therefore be added together and their sum divided by 8, the quotient is the correct magnetic bearing, and it is named N and E the same as all the bearings.

To Find the Deviations.

Correct.....	N 45° E	N 45° E	N 45° E	N 45° E
Standard	N 41 E	N 54 E	N 58 E	N 51 E
Deviations.....	4 E	9 W	18 W	6 W

Correct.....	N 45° E	N 45° E	N 45° E	N 45° E
Standard	N 47 E	N 42 E	N 35 E	N 32 E
Deviations	2 W	8 E	10 E	18 E

Place the Standard Compass Bearing with the ship's head North, namely N 41° E, under the correct magnetic bearing N 45° E; and as they are both of the same name, namely N and E, take their difference which will be the deviation when the ship's head is North.

Proceed in the same manner with the Standard Compass when the ship's head is N.E., and so on in regular order as arranged above, and thus the deviation with the ship's head on every point will be found.

To Name the Deviations.

Draw two lines at right angles to each other to represent the N, S, E and W, points of the Compass; from I, their point of intersection, draw a line I C in the N E quadrant to represent the correct magnetic bearing, and other two lines I s, I s, one on each side of I C to represent the Standard Compass bearings, place the point of a pencil on C, look from I along I C, then if the correct magnetic bearing be to the right hand of the Standard Compass bearing the deviation is East, but if it be to the left, the deviation is West; these rules may shortly expressed thus:

C right of s, deviation E.

C left of s, deviation W.

See page 228 Bergen's Navigation.

To Draw a Deviation Curve.

See pages 228 and 229 Bergen's Navigation. With a pair of dividers, take 4° the deviation with the ship's head North from the scale on the middle line and apply it to the North point at each end of the diagram, upwards when the deviation is East, from the middle line along the dotted line, or along the dotted line produced. Make a small pencil mark at the upper point of the dividers.

Next, take 9° the deviation opposite N E, from the scale, and apply it in the same manner along the dotted line, passing through N E on the middle line, downward when the deviation is W. Proceed in a similar manner with all the deviations.

The Rules for drawing the curve are concisely expressed thus:

Go along dotted, upward when East, downward when West. Draw a faint pencil line fair through all the dots, and when satisfied with it draw it in with ink.

To Shape the Course by the Standard Compass.

8. With the deviations as above, give the courses you would steer by the Standard Compass to make the following courses, correct magnetic.

Correct magnetic ...E N E;	E by S;	S W by S;	W N W
Standard .....N 81° E;	S 68° E;	S 82° W;	N 79° W

Remarks. Place one foot of a pair of dividers on the middle line at E N E, the first correct magnetic course, and the other foot at the point where the curve meets the plain line through E N E.

Then, keep the foot on the middle line line fixed, and bring the other foot to the middle line so that a line drawn through the point on the curve where the foot was and the point on the middle line where it is now, may be parallel to the dotted line, then the foot will touch the middle line at the point marked N 81° E, which is the course that must be steered by the Standard Compass.

When the courses do not pass along either plain or dotted lines; go from the middle line parallel to the plain lines and return to it parallel to the dotted lines, or shortly *go by plain, return by dotted*.

To Correct the Course Steered by the Standard Compass for Deviation.

9. Supposing you have steered the following Courses by the Standard Compass, find the correct Magnetic Courses made from the above Deviations.

Standard Courses...N $E \frac{1}{4}$ E;	E by S;	W;	W by N;
Correct Magnetic...N 44° E;	N 89° E;	N 80° W;	N 67° W;

Short Rule. Go by dotted, return by plain.

To Correct the Bearings of Two Distant Objects by the Standard Compass for the Deviation due to the Ship's Course.

10. You have taken the following bearings of two distant objects by your Standard Compass as above; with the ship's head at N N E, find the bearings correct magnetic.

First bearing South = S 0° E.	Second bearing W $\frac{1}{4}$ N = N 82° W.
Deviation 3 W	Deviation 3 W.
Correct Magnetic bearing S 3 E	Correct N 85 W.

Rule. Go by dotted; allow East Deviation to right, West to left.

Place one foot of the dividers on the middle line, and the other at the point where the curve crosses the dotted line. The distance measured between the points of the dividers, applied along the middle line from the North or South point shows the deviation to be 3° , and as the curve is below the middle line at the N N E point the deviation is W. Hence the first correct bearing is S 3° E, and the second is N 85° W.

EXAMPLE II.

7. In the following Table give the Correct Magnetic Bearing of the distant object, and thence the deviation.

Ship's Head by Standard Compass.	Bearing of Distant Object by Standard Compass.	Deviation Required.	Ship's Head by Standard Compass.	Bearing of Distant Object by Standard Compass.	Deviation Required.
North	N 86° W	24° W	South	S 58° W	17° E
NE	W 22 S	2 E	SW	W 28 S	8 E
East	S 58 W	12 E	West	S 77 W	7 W
SE	S 55 W	15 E	NW	N 89 W	21 W

To Find the Correct Magnetic Bearings.

See page 238 Bergen's Navigation.

As the Compass bearings are here reckoned from different points, they must be reduced to equivalent bearings, so that all the bearings may be reckoned from the same point; and as there are more reckoned from the South point than from any other, it will be convenient to reckon them all from that point; as follows :

180°; N 86 W ;	90°; W 22 S ;	90°; W 28 S ;	180° N 89 W
<u>S 94 W</u>	<u>S 68 W</u>	<u>S 62 W</u>	<u>S 91 W</u>

Next, arrange the bearings, both those given for the South point and the equivalents of the others, in regular order ; beginning with the equivalent for the position of the ship's head North, and then with that of her head N E, and so on as follows.

S 94 W	S 58 W
S 68 W	S 62 W
S 58 W	S 77 W
S 55 W	S 91 W
<u>275</u>	<u>288</u>
	<u>275</u>

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69½ say = S 70° W Correct Magnetic Bearing.

To Find the Deviations, Correct and Standard.

Same name take difference.

*Rules.**C* right of *s* Deviation *E*.*C* left of *s* Deviation *W*.

Correct.....	S 70° W;	S 70° W;	S 70° W;	S 70° W;
Standard	S 94° W;	S 68° W;	S 58° W;	S 55° W;
Deviations ...	24° W;	2° E;	12° E;	15° E;
Correct.....	S 70° W;	S 70° W;	S 70° W;	S 70° W;
Standard	S 53° W;	S 62° W;	S 77° W;	S 91° W;
	17° E;	8° E;	7° W;	21° W;

To Shape a Course by the Standard Compass.

8. With the deviations as above, give the course you would steer by the Standard Compass to make the following courses correct magnetic.

Rule. Go by plain, return by dotted.

Magnetic.....	N N E	E N E	West	N W
Standard.....	N 81° E	N 60° E	N 80° W	N 21° W

To Correct the Course Steered by the Standard Compass for Deviation.

9. Supposing you have steered the following courses by the Standard Compass, find the correct magnetic courses made from the above deviation table.

Rule. Go by dotted, return by plain.

Standard.....	N N E	E N E	West	N W
Magnetic.....	N 7° E	N 77° E	S 88° W	N 66° W

Cross Bearings.

10. You have taken the following bearings of two distant objects by your Standard Compass as above; with the ship's head at NW by W, find the bearings, correct magnetic.

Rule. Go by dotted.

1st bearing S by W, say = S 11° W.	2nd bearing E by S = S 79° E
Deviation for ship's head ... 18 W	18 W
Correct magnetic bearing... S 7 E	S 97 E
	180
	N 83 E

EXAMPLE III.

7. In the following Table give the correct magnetic bearing of the distant object, and thence the deviation.

Ship's Head by Standard Compass.	Bearing of Distant Object by Standard Compass.	Deviation Required.	Ship's Head by Standard Compass.	Bearing of Distant Object by Standard Compass.	Deviation Required.
North	N 10° W	6° E	South	N 3° W	1° W
NE	N 15 W	11 E	SW	N 19 E	23 W
East	N 19 W	15 E	West	N 15 E	19 W
SE	N 20 W	16 E	NW	N 4 E	8 W

As some of the bearings in this question are in the NW quadrant, and others in the NE quadrant, add all the Westings together, and all the Eastings together, take the difference of the sums and divide it by 8, the quotient will be the correct magnetic bearing, as follows :

N 10 W	N 19 E
N 15 W	N 15 E
N 19 W	N 4 E
N 20 W	
N 3 W	Sum of Eastings N 38 E
	Sum of Westings N 67 W
Sum N 67 W	
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Correct magnetic bearing... $8\frac{1}{8}$, say = N 4° W.

To Find the Deviations.

Correct... N 4° W	N 4° W	N 4° W	N 4° W
Standard N 10 W	N 15 W	N 19 W	N 20 W
Deviations 6 E	11 E	15 E	16 E

Correct... N 4° W	N 4° W	N 4° W	N 4° W
Standard N 8 W	N 19 E	N 15 E	N 4 E
1 W	23 W	19 W	8 W

Rules. Correct and Standard ; same name take difference, different name take sum.

C right of *s* deviation *E*.

C left of *s* deviation *W*.

To Shape the Course by the Standard Compass.

8. With the deviations as above, give the courses you would steer by the Standard Compass to make the following courses correct magnetic.

Correct..... N by E	E by N	S W by S	W N W
Standard N 4° E	N 66° E	S 57° W	N 57° W

Rule. Go by plain, return by dotted.

To Correct the Course Steered by the Standard Compass for Deviation.

9. Supposing you have steered the following courses by the Standard Compass, find the correct magnetic courses made from the above deviations.

Standard..... N E by N	E S E	W by S	N W by N
Correct N 44° E	S 52° E	S 58° W	N 38° E

Rule. Go by dotted, return by plain.

Cross Bearings.

10. You have taken the following bearings of two distant objects by your Standard Compass as above, with the Ship's Head at W S W ; find the bearings, Correct Magnetic.

Rule. Go by dotted, allow *E* dev. to right, *W* dev. to left.

1st bearing North, = N 0° E	2nd bearing East, = N 90° E
Dev. 23 W	Dev. 23 W
Correct magnetic bearing, N 23 W	Correct N 67 E

EXAMPLE IV.

7. In the following Table, give the correct magnetic bearing of the distant object, and thence the deviation.

Ship's Head by Standard Compass.	Bearing of Distant Object by Standard Compass.	Required Deviation.	Ship's Head by Standard Compass.	Bearing of Distant Object by Standard Compass.	Required Deviation.
North	W 86° N	0°	South	W 98° N	2° W
NE	W 18 N	28 E	SW	N 40 W	14 W
East	W 12 N	24 E	West	N 90 W	24 W
SE	W 24 N	12 E	NW	N 92 W	22 W

As the most of the bearings in this question are taken from the West point towards the North, it will be convenient to reduce the remaining bearings to their equivalents, reckoned from the West point thus :

N 40° W

90

W 50 N

N 80° W

90

W 60 N

N 92° W

90

W 58 N

To Find the Correct Magnetic Bearing.

W 86 N

W 18 N

W 12 N

W 24 N

85

W 98 N

W 50 N

W 60 N

W 58 N

206

85

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86½ say = W 86° N.

To Find the Deviations.

Correct.....

Standard

Deviation.....

W 86 N

W 86 N

0

W 86 N

W 18 N

28 E

W 86 N

W 12 N

24 E

W 86 N

W 24 N

12 E

Correct.....	W $\overset{\circ}{86}$ N	W $\overset{\circ}{86}$ N	W $\overset{\circ}{86}$ N	W $\overset{\circ}{86}$ N
Standard	W $\overset{\circ}{88}$ N	W $\overset{\circ}{50}$ N	W $\overset{\circ}{60}$ N	W $\overset{\circ}{58}$ N
Deviation.....	<u>2 W</u>	<u>14 W</u>	<u>24 W</u>	<u>22 W</u>

Rules. Correct and Standard same name take difference.

C right of s, deviation E
C left of s, deviation W.

To Shape the Compass Course.

8. With the deviations as above, give the course you would steer by the Standard Compass to make the following Courses correct magnetic.

Correct.....	ENE	SE	W by S	NNW
Standard ...	N 45° E	S 69° E	N 76° W	N 14° W

Rule. Go by plain, return by dotted.

To Correct the Compass Course for Deviation.

9. Supposing you have steered the following courses by the Standard Compass, find the correct magnetic course made from the above deviations.

Standard NNE	E $\frac{1}{2}$ N	SW	WNW
Correct N 88° E	S 71° E	S 81° W	S 87° W

Rule.—Go by dotted, return by plain.

To Correct the Compass Bearings.

10. You have taken the following bearings of two distant objects by your Standard Compass, as above, with the Ship's head at ESE, find the bearings correct magnetic.

Rules. Go by dotted. Allow E deviation to right, W deviation to left.

1st bearing SE = S 45° E	2nd bearing SW by W = S 56° W
Dev. <u>19E</u>	Dev. <u>19E</u>
Answer <u>S 26° E</u>	Answer <u>S 75° W</u>

EXERCISES.

EXERCISE I.

7.

Ship's head.	Compass Bearing.	Deviation.	Ship's Head.	Compass Bearing.	Deviation.
N	N 6°W		S	N 52°E	
NE	N 1 E		SW	N 51 E	
E	N 18 E		W	N 25 E	
SE	N 37 E		NW	N 1 W	

8. N by E SE by E S $\frac{1}{2}$ E S by W

9. SE S by W WSW N by W

10. Ship's head SSW. 1st bearing W by N, 2nd bearing E by S.

Note. In this Exercise, one of the given courses in 8 is N by E, and one in 9 is N by W, and the deviations are large at those points, so that the required corresponding courses are beyond the limits of the diagram; in this case bring the ends of the diagram together so that all the lines may correspond, then complete the curve, and find the required courses.

Thus, for the course N by E in 8, produce the plain line at North near the word diagram, extend the curve at that end by taking the deviation along the plain line at the other end, and applying it to the plain line produced at the first mentioned end; then from N by E go by plain return by dotted; find the distance from the North point to where the other leg of the dividers meets the middle line produced, apply it to the scale, and the required course is found to be N 16° W.

The required course at N by W in 9 is found in a similar manner.

EXERCISE II.

7.

Ship's Head.	Compass Bearing.	Deviation.	Ship's Head.	Compass Bearing.	Deviation.
N	N 3°E		S	N 31°E	
NE	N 8 W		SW	N 35 E	
E	N 1 E		W	N 33 E	
SE	N 19 E		NW	N 22 E	

8. N $\frac{1}{2}$ E W by S WSW N $\frac{1}{2}$ W

9. NNE E by N SW W by N

10. Ship's head E by N. 1st bearing E; 2nd bearing S.

EXERCISE III.

7.

Ship's Head.	Compass Bearing.	Deviation.	Ship's Head.	Compass Bearing.	Deviation.
N	W 86°N		S	W 88°N	
NE	W 18 N		SW	N 40 W	
E	W 12 N		W	N 80 W	
SE	W 24 N		NW	N 82 W	

8. NNE ENE SE W by S

9. E by S South WSW NW by W

10. Ship's head ESE. 1st bearing SE ; 2nd bearing SW by W.

EXERCISE IV.

7.

Ship's Head.	Compass Bearing.	Deviation.	Ship's Head	Compass Bearing.	Deviation.
N	N 12°W		S	N 14°W	
NE	N 19 W		SW	N 8 W	
E	N 24 W		W	N 1 W	
SE	N 19 W		NW	N 5 W	

8. N E by N E S E S W by W NW

9. E by N S $\frac{1}{2}$ E W by S NNW

10. Ship's head E by N. 1st bearing E ; 2nd bearing S.

EXERCISE V.

7.

Ship's Head.	Compass Bearing.	Deviation.	Ship's Head.	Compass Bearing.	Deviation.
N	N 7°W		S	N 5°W	
NE	N 2 W		SW	N 21 W	
E	N 5 E		W	N 18 W	
SE	N 2 E		NW	N 10 W	

8. N by E SE S W by W NNW

9. NE by N E $\frac{1}{2}$ N S $\frac{1}{2}$ W W

10. Ship's head W by S. 1st bearing NNE ; 2nd bearing ESE.

EXERCISE VI.

7.

Ship's Head.	Compass Bearing.	Deviation.	Ship's Head.	Compass Bearing.	Deviation.
N	N 20°W		S	N 38°W	
NE	N 15 W		SW	N 46 W	
E	N 9 W		W	N 40 W	
SE	N 14 W		NW	N 26 W	

8. N $\frac{1}{2}$ E SE $\frac{1}{2}$ S S by W $\frac{1}{2}$ W W $\frac{1}{2}$ N9. N by E $\frac{1}{2}$ E E $\frac{1}{2}$ S S by W $\frac{1}{2}$ W N $\frac{1}{2}$ W

10. Ship's head E by S. 1st bearing W; 2nd bearing N.

EXERCISE VII.

7.

Ship's Head.	Compass Bearing.	Deviation.	Ship's Head.	Compass Bearing.	Deviation.
N	N 7°W		S	N 2°W	
NE	N 12 W		SW	N 17 E	
E	N 17 W		W	N 14 E	
SE	N 18 W		NW	N 1 E	

8. NNE ESE S $\frac{1}{2}$ E W by S9. NNE ESE S $\frac{1}{2}$ E W by S

10. Ship's head SE by E. 1st bearing E; 2nd bearing S

EXERCISE VIII.

7.

Ship's Head.	Compass Bearing.	Deviation.	Ship's Head.	Compass Bearing.	Deviation.
N	S 64°E		S	E 16°N	
NE	E 7 S		SW	E 4 S	
E	E 12 N		W	N 112 E	
SE	N 67 E		NW	S 58 E	

8. NNE $\frac{1}{2}$ E E by S SW $\frac{1}{2}$ W NW

9. NNE E by N WSW NW

10. Ship's head ESE. 1st bearing E by N; 2nd bearing S by E.

EXERCISE IX.

7.

Ship's Head.	Compass Bearing.	Deviation.	Ship's Head.	Compass Bearing.	Deviation.
N	N 52° E		S	E 5° S	
NE	E 84 N		SW	E 1 N	
E	E 17 N		W	S 105 E	
SE	S 87 E		NW	E 33 N	

8. NE by N E $\frac{1}{4}$ N SSE NW by N9. N $\frac{1}{2}$ E SE by S SSW W $\frac{1}{4}$ N10. Ship's head S by E $\frac{1}{2}$ E. 1st bearing ENE ; 2nd bearing S by E.

EXERCISE X.

7.

Ship's Head.	Compass Bearing.	Deviation.	Ship's Head.	Compass Bearing.	Deviation.
N	E 29° S		S	E 21° S	
NE	S 45 E		SW	E 1 N	
E	S 87 E		W	N 86 E	
SE	E 49 E		NW	E 7 S	

8. NE $\frac{1}{4}$ E ENE WSW W by N9. N $\frac{1}{2}$ E S $\frac{1}{2}$ E SW W by S

10. Ship's head S W by S. 1st bearing N by W ; 2nd bearing W by S.

EXERCISE XI.

7.

Ship's Head.	Compass Bearing.	Deviation.	Ship's Head.	Compass Bearing.	Deviation.
N	E 3° S		S	E 25° N	
NE	E 27 N		SW	S 88 E	
E	E 46 N		W	S 67 E	
SE	N 48 E		NW	E 24 S	

8. NE by E E by S W by S NW

9. NNE S SW NNW

10. Ship's head WSW. 1st bearing S by W ; 2nd bearing W by S.

EXERCISE XII.

7.

Ship's Head.	Compass Bearing.	Deviation.	Ship's Head.	Compass Bearing.	Deviation.
N	S 45° W		S	S 51° W	
NE	S 25 W		SW	S 60 W	
E	S 27 W		W	S 68 W	
SE	S 40 W		NW	S 66 W	

8. N $\frac{1}{2}$ E E $\frac{1}{2}$ S S by E $\frac{1}{4}$ E SW $\frac{1}{4}$ W

9. E by S $\frac{1}{4}$ S SW $\frac{1}{4}$ S NW $\frac{1}{4}$ W NW $\frac{1}{4}$ W

10. Ship's head E by S. 1st bearing SE. 2nd bearing SW.

ANSWERS TO EXERCISES IN THE CURVES.

EXERCISE I.

7. Correct magnetic bearing N 22°E. Deviations 28°E, 21°E, 4°E, 15°W, 30°W, 29°W, 3°W, 28°E.
8. Courses to steer by compass, N 16°W, S 39°E, S 26°W, S 41°W.
9. Correct magnetic courses, S 60°E, S 20°E, S 49°W, N 17°E.
10. Correct magnetic bearings S 69°W, N 69°E. Deviation for ship's head 32°W.

EXERCISE II.

7. Correct magnetic bearing N 17°E. Deviations 14°E, 25°E, 16°E, 2°W, 14°W, 18°W, 16°W, 5°W.
8. Courses to steer by compass, N 6°W, N 86°W, S 85°W, N 14°W.
9. Correct magnetic courses, N 44°E, S 82°E, S 27°W, S 87°W.
10. Deviation for ship's head 20°E. Correct magnetic bearings S 70°E, S 20°W.

EXERCISE III.

7. Correct magnetic bearing, W 86°N. Deviation 0°, 23°E, 24°E, 12°E, 2°W, 14°W, 24°W, 22°W.
8. Courses to steer by compass, N 13°E, N 45°E, S 62°E, N 76°W.
9. Correct magnetic courses, S 57°E, S 2°E, S 48°W, N 52°W.
10. Deviation for ship's head 19°E. Correct magnetic bearings S 26°E, S 75°W.

EXERCISE IV.

7. Correct magnetic bearing N 18°W. Deviations 1°W, 6°E, 11°E, 6°E, 1°E, 5°W, 12°W, 8°W.
8. Courses to steer by compass, N 30°E, S 77°E, S 65°W, N 38°W.
9. Correct magnetic courses, N 89°E, S 4°E, S 68°W, N 27°W.
10. Deviation for ship's head 10°E. Correct magnetic bearings, S 80°E, S 10°W.

EXERCISE V.

7. Correct magnetic bearing N 7°W. Deviations 0°, 5°N, 12°W, 9°W, 2°W, 14°E, 11°E, 8°E.
8. Courses to steer by compass, N 18°E, S 37°E, S 48°W, N 23°W.
9. Correct magnetic courses N 30°E, N 73°E, S 6°W, N 80°W.
10. Deviation for ship's head, 13°E. Correct magnetic bearings N 36°E, S 55°E.

EXERCISE VI.

7. Correct magnetic bearing N 25°W. Deviations 5°W, 10°W, 16°W, 11°W, 8°E, 21°E, 15°E, 1°E.
8. Courses to steer by compass N 12°E, S 35°E, S 5°W, S 78°W.
9. Correct magnetic courses, N 11°E, N 80°E, S 28°W, N 10°W.
10. Deviation for ship's head, 16°W. Correct magnetic bearings, S 74°W, N 16°W.

EXERCISE VII.

7. Correct magnetic bearing N 3°W. Deviations 4°E, 9°E, 14°E, 15°E, 1°W, 20°W, 17°W, 4°W.
8. Courses to steer by compass, N 17°E, S 82°E, S 3°E, N 86°W.
9. Correct magnetic courses, N 29°E, S 52°E, S 8°E, S 60°W.
10. Deviation for ship's head, 16°E. Correct magnetic bearings S 74°E, S 16°W.

ANSWERS TO EXERCISES IN THE CURVES.

EXERCISE I.

7. Correct magnetic bearing N 22°E. Deviations 28°E, 21°E, 4°E, 15°W, 80°W, 29°W, 8°W, 28°E.
8. Courses to steer by compass, N 16°W, S 89°E, S 26°W, S 41°W.
9. Correct magnetic courses, S 60°E, S 20°E, S 49°W, N 17°E.
10. Correct magnetic bearings S 69°W, N 69°E. Deviation for ship's head 82°W.

EXERCISE II.

7. Correct magnetic bearing N 17°E. Deviations 14°E, 25°E, 16°E, 2°W, 14°W, 18°W, 16°W, 5°W.
8. Courses to steer by compass, N 6°W, N 86°W, S 85°W, N 14°W.
9. Correct magnetic courses, N 44°E, S 82°E, S 27°W, S 87°W.
10. Deviation for ship's head 20°E. Correct magnetic bearings S 70°E, S 20°W.

EXERCISE III.

7. Correct magnetic bearing, W 86°N. Deviation 0°, 28°E, 24°E, 12°E, 2°W, 14°W, 24°W, 22°W.
8. Courses to steer by compass, N 18°E, N 45°E, S 62°E, N 76°W.
9. Correct magnetic courses, S 57°E, S 2°E, S 48°W, N 52°W.
10. Deviation for ship's head 19°E. Correct magnetic bearings S 26°E, S 75°W.

EXERCISE IV.

7. Correct magnetic bearing N 18°W. Deviations 1°W, 6°E, 11°E, 6°E, 1°E, 5°W, 12°W, 8°W.
8. Courses to steer by compass, N 30°E, S 77°E, S 65°W, N 88°W.
9. Correct magnetic courses, N 89°E, S 4°E, S 68°W, N 27°W.
10. Deviation for ship's head 10°E. Correct magnetic bearings, S 80°E, S 10°W.

EXERCISE V.

7. Correct magnetic bearing N 7°W. Deviations 0°, 5°N, 12°W, 9°W, 2°W, 14°E, 11°E, 3°E.
8. Courses to steer by compass, N 18°E, S 37°E, S 43°W, N 23°W.
9. Correct magnetic courses N 30°E, N 73°E, S 6°W, N 80°W.
10. Deviation for ship's head, 13°E. Correct magnetic bearings N 36°E, S 55°E.

EXERCISE VI.

7. Correct magnetic bearing N 25°W. Deviations 5°W, 10°W, 16°W, 11°W, 8°E, 21°E, 15°E, 1°E.
8. Courses to steer by compass N 12°E, S 35°E, S 5°W, S 78°W.
9. Correct magnetic courses, N 11°E, N 80°E, S 28°W, N 10°W.
10. Deviation for ship's head, 16°W. Correct magnetic bearings, S 74°W, N 16°W.

EXERCISE VII.

7. Correct magnetic bearing N 3°W. Deviations 4°E, 9°E, 14°E, 15°E, 1°W, 20°W, 17°W, 4°W.
8. Courses to steer by compass, N 17°E, S 82°E, S 8°E, N 86°W.
9. Correct magnetic courses, N 29°E, S 52°E, S 3°E, S 60°W.
10. Deviation for ship's head, 16°E. Correct magnetic bearings S 74°E, S 16°W.

EXERCISE VIII.

7. Correct magnetic bearing, S 85°E. Deviations 21°W, 2°W, 17°E, 28°E, 21°E, 1°E, 17°W, 27°W.
8. Courses to steer by compass, N 85°E, N 86°E, S 48°W, N 20°W.
9. Correct magnetic courses, N 9°E, S 89°E, S 59°W, N 72°W.
10. Deviation for ship's head, 25°E. Correct magnetic bearings S 76°E, S 14°W.

EXERCISE IX.

7. Correct magnetic bearing, N 74°E. Deviations 22°E, 18°E, 1°E, 19°W, 21°W, 15°W, 1°W, 17°E.
8. Courses to steer by compass, N 11°E, N 84°E, S 1°E, N 49°W.
9. Correct magnetic courses, N 28°E, S 55°E, S 4°W, N 88°W.
10. Deviation for ship's head, 22°W. Correct magnetic bearings, N 46°E, S 88°E.

EXERCISE X.

7. Correct magnetic bearing E 25°S. Deviations 4°W, 20°W, 28°W, 24°W, 4°E, 26°E, 29°E, 18°E.
8. Courses to steer by compass, N 77°E, S 85°E, S 48°W, S 72°W.
9. Correct magnetic courses, N 1°W, S 6°E, S 71°W, N 72°W.
10. Deviation for ship's head, 22°E. Correct magnetic bearings, N 11°E, N 79°W.

EXERCISE XI.

7. Correct magnetic bearing E 11°N. Deviations 14°W, 16°E, 85°E, 81°E, 14°E, 18°W, 84°W, 85°W.
8. Courses to steer by compass, N 42°E, N 72°E, N 65°W, N 20°W.
9. Correct magnetic courses, N 24°E, S 14°W, S 98°W, N 50°W.
10. Deviation for ship's head 25°W. Correct magnetic bearings, S 14°E, S 54°W.

EXERCISE XII.

7. Correct magnetic bearing S 48° W. Deviations 8° E, 28° E, 21° E, 8° E, 8° W, 12° W, 20° W, 18° W.
8. Courses to steer by compass, N 1° E, N 72° E, S 19° E, S 64° E.
9. Correct magnetic courses, S 58° E, S 86° W, N 78° W, N 66° W.
10. Deviation for ship's head, 18° E. Correct magnetic bearings S 27° E, S 63° E.

SUMNER'S METHOD.

In the following Examination Paper, the M.T.G. is given, and the declination and equation of time are corrected for the time from the nearest noon. Then with the first assumed latitude $49^{\circ} 50'N$ the longitude is found exactly as in finding the longitude by chronometer.

The process is repeated with the same altitude and polar distance, and the second assumed latitude $50^{\circ} 20'N$.

Note. See Arts. 98, 99, 100, and 222, Bergen's Navigation.

Exn. 6. a.

Port of _____

Rotation No.

EXAMINATION PAPER.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A

Issued by the
Board of Trade,
in pursuance of
17 and 18 Vic.,
c. 104.

FIRST MATE.

To be used at the above Port this _____ day of _____

N.B. A Candidate for a First Mate's Certificate of Competency will be required to work the questions in Papers Exn. 4, Exn. 5, and Exn. 6, in addition to the questions in this Paper.

If at sea on November 23rd, 1876, A.M., and uncertain of my position, when a chronometer shewed 22d 20h 21m 15s G.M.T. Suppose the observed altitude of the Sun's L.L. be $5^{\circ} 42' 30''$, and again P.M. the same day, when the chronometer shewed 23d 1h 50m 27s G.M.T., the observed altitude of the sun's L.L. be $14^{\circ} 25' 54''$. The ship have made 26 miles on a true West course in the interval. Height of the eye 17 feet. Required the line of bearing when the first altitude was taken, and the position of the Ship by "Sumner's Method" when the second altitude was observed, assuming the latitudes $49^{\circ} 50'N$ and $50^{\circ} 20'N$.

ace for Minor Corrections

M.T.G. 1876.				
	d	h	m	s
November	22	20	21	15
	23	0	0	0
	8 38 45			
	3-6			

Cosec.				
20	27	0	0-028271	
			+ 47	
110	27	59		
			0-028318	

Diff. 79
59

711
895

46,61

Cos.

83	1	0	9-084864
			- 1015
83	1	59	9-083849
			Diff. 1721
			59
			15489
			8605
			1015,39

Cos.

83	16	0	9-069107
			- 1054
83	16	59	9-068053
			Diff. 1786
			59
			16074
			8930
			1053,74

CALCULATION.

FIRST LINE OF BEARING.

Var.	Dec.	Eq. T.	Var.
80° 69	20 29 49 S	m s — 13 16-21	724
3-6	— 1 50	+ 2-61	3-6
18414	20 27 59	— 18 18-82	4844
9207	90 0 0		2172
60)11,0-484	P.D.110 27 59		2-6064
1 50-4			

ASSUMED LATITUDE 49° 50' N.

Obs. alt. 5 42 30	Alt... 5 45 59	
Dip... — 4 4	Lat.. 49 50 0	Sec... 0-190431
	P.D.. 110 27 59	Cosec. 0-028318
	5 88 26	
Corr... — 8 42	2)166 3 58	
	5 29 44	83 1 59
Sem... + 16 15	77 16 0	Cos... 9-083849
		Sin... 9-989186
True alt. 5 45 59		
	h m s	Log... 9-291784
	H.A... 20 29 54	92
	Eq. T. — 13 19	
	d	14-2
	M.T.S. Nov... 22 20 16 35	
	M.T.G. Nov... 22 20 21 15	
	0 4 40	
	60 0	
	4)4 40	

Longitude 1° 10' West.

ASSUMED LATITUDE 50° 20' N.

Alt... 5 45 59	
Lat.. 50 20 0	Sec... 0-194961
P.D. 110 27 59	Cosec. 0-028318
2)166 33 58	
83 16 59	Cos... 9-068053
77 31 0	Sin... 9-989609
h m s	
H.A. 20 32 42	Log.. 9-280941
Eq. T. — 13 19	109
d	15-2
22 20 19 23	M.T.S. Nov.
22 20 21 15	M.T.G. Nov.
0 1 52	
60 60	
4)1 112	

Longitude 0° 28' West.

PROJECTION OF THE CHART.

Draw the assumed parallels of latitude, and mark both positions as found by the preceding calculation, on the chart; call the position on the lower latitude A and that on the higher latitude B. Draw a straight line through A and B; this line will be the *first line of bearing*. Find its direction by the compass, and express it in degrees. It is true $N42^{\circ}E$.

Next, take any point P in the line A B, set off the true course West, and the distance, 26 miles, run in the interval to a point C.

Through C draw a line parallel to A B, and mark it A' B', which are read A dash and B dash respectively.

Now, suppose the ship's computed positions, at the time of taking the second altitude, to be as follows: where D and E denote the respective positions on the chart.

D	E
Latitude $49^{\circ} 50' N$	Latitude $50^{\circ} 20' N$
Longitude $0 13\frac{1}{4}W$	Longitude $1 37\frac{1}{4}W$

Find the ship's position on the chart at the time of taking the second altitude. Proceed as follows:—Mark the given positions D and E on the chart. Draw a line from D to E; this line will be the *second line of bearing*. Mark the point where it intersects the line A' B' by the letter S; then S is the ship's position at the time of taking the second altitude, and by the chart it is in latitude $50^{\circ} 18' N$, Longitude $1^{\circ} 18' W$.

To find the Sun's Bearing.

The first altitude was taken in the forenoon and when the ship was North of the sun. In this case, look from A to B, and allow 90° to the right hand of the first line of bearing, thus :—

First line	N $42^{\circ}E$ true
Allow to right	90
	—————
	N $182^{\circ} E$
	180
	—————
Sun's bearing	S $48^{\circ} E$ true

Notes 1. In Sumner's Method the longitudes given by the Examiners are found with the given assumed latitudes; the second altitude and the declination and equation of time due to the second, Greenwich date.

2. The first line of bearing being produced meets the land about 8 miles to the West of Beachy Head. See Arts. 99 and 100, pages 143 and 144, Bergen's Navigation, for some remarks on the utility of this problem, and a modification of it.

EXERCISES.

1. If at Sea on March 15th, 1865, A.M., and uncertain of my position, when a Chronometer shewed 14d. 20h. 10m. 51s. G.M.T. Suppose the observed altitude of the Sun's L.L. be $14^{\circ} 14' 0''$, and again P.M. the same day, when the Chronometer shewed 15d. 3h. 45m. 9s. G.M.T. the observed altitude of the Sun's L.L. be $23^{\circ} 17' 0''$. The ship have made 21 miles on a true course N by E $\frac{1}{4}$ E in the interval. Height of the eye 16 feet. Required the line of bearing when the first altitude was taken, and the position of the Ship by "Sumner's Method" when the second altitude was observed; assuming the latitudes $49^{\circ} 0' N$ and $49^{\circ} 40' N$.

Again; suppose the Ship's calculated position at the time of taking the second altitude to be as follows:—

D.	E.
Latitude $49^{\circ} 0' N$	Latitude $49^{\circ} 40' N$
Longitude 4 17 W	Longitude 4 58 $\frac{1}{2}$ W

Find the Ship's position on the chart at the time of taking the second altitude?

2. If at sea on April 5th, 1866, P.M. and uncertain of my position, when a Chronometer shewed 6d. 1h. 17m. 25s. G.M.T. Suppose the observed altitude of the Sun's L.L. be $45^{\circ} 7' 10''$, and again P.M. the same day, when the Chronometer shewed 6d. 4h. 23m. 24s. G.M.T. the observed altitude of the Sun's L.L. be $24^{\circ} 52' 10''$. The ship have made 46 miles on a true N.E. course in the interval. Height of the eye 18 feet. Required the line of bearing when the first altitude was taken, and the position of the ship by "Sumner's Method" when the second altitude was observed; assuming the latitudes $50^{\circ} 10' N$ and $50^{\circ} 30' N$.

Again; suppose the Ship's calculated position at the time of taking the second altitude to be as follows:—

D.	E.
Latitude $50^{\circ} 30' N$	Latitude $51^{\circ} 0' N$
Longitude 7 17 W	Longitude 7 36 W

Find the Ship's position on the chart at the time of taking the second altitude?

NOTE.—In this question, the given course and distance sailed, takes the Ship to the Northward of the higher assumed latitude, it is therefore taken as the lower assumed latitude for the second line of bearing.

3. If at sea on January 12th, 1876, A.M., and uncertain of my position, when a Chronometer shewed 11d. 21h. 29m. 51s. G.M.T. Suppose the observed altitude of the Sun's L.L. be $6^{\circ} 18' 30''$, and again P.M., the same day when the Chronometer shewed 12d. 3h. 55m. 30s. G.M.T. the observed altitude of the L.L. be $5^{\circ} 39' 0''$. The Ship have made 32 miles on a true S.E. by E. $\frac{1}{4}$ E. course in the interval. Height of the eye 21 feet. Required the line of bearing when the first altitude was taken, and the position of the

Ship by "Sumner's Method" when the second altitude was observed; assuming the latitudes $50^{\circ} 0' N$ and $51^{\circ} 0' N$.

Again; suppose the Ship's position at the time of taking the second altitude to be as follows:—

D.		E.	
Latitude	$50^{\circ} 0' N$	Latitude	$51^{\circ} 0' N$
Longitude	$6 88 W$	Longitude	$8 6\frac{1}{2} W$

Find the Ship's position on the chart at the time of taking the second altitude ?

4. If at sea on February 24th, 1876, A.M., and uncertain of my position, when a Chronometer shewed 23d 21h 14m 46s G.M.T. Suppose that the observed altitude of the Sun's L.L. be $15^{\circ} 15' 20''$, and again P.M. the same day when the Chronometer shewed 24d 2h 37m 17s G.M.T., the observed altitude of the Sun's L.L. be $24^{\circ} 48' 0''$. The ship have made 81 miles on a true NE $\frac{1}{2}$ E course in the interval. Height of the eye 23 feet. Required the line of bearing when the first altitude was taken, and the position of the Ship by "Sumner's Method" when the second altitude was observed; assuming the latitudes $50^{\circ} 0' N$ and $50^{\circ} 30' N$.

Again; suppose the Ship's position at the time of taken the second altitude to be as follows:—

D.		E.	
Latitude	$50^{\circ} 0' N$	Latitude	$50^{\circ} 30' N$
Longitude	$5 48 W$	Longitude	$6 56\frac{1}{2} W$

Find the Ship's position on the chart at the time of taken the second altitude ?

5. If at sea on March 9th, 1876, A.M., and uncertain of my position, when a Chronometer shewed 8d 21h 85m 2s G.M.T. Suppose the observed altitude of the Sun's L.L. be $22^{\circ} 27' 30''$, and again P.M. the same day when the Chronometer shewed 9d 1h 48m 29s G.M.T., the observed altitude of the Sun's L.L. be $32^{\circ} 34'$. The Ship have made 18 miles on a true WNW course in the interval. Height of the eye 19 feet. Required the line of bearing when the first altitude was taken, and the position of the Ship by "Sumner's Method" when the second altitude was observed; assuming the latitudes $51^{\circ} 0' N$ and $51^{\circ} 30' N$.

Again; suppose the Ship's position at the time of taken the second altitude to be as follows:—

D.		E.	
Latitude	$51^{\circ} 0' N$	Latitude	$51^{\circ} 30' N$
Longitude	$5 32 W$	Longitude	$7 45 \frac{1}{2} W$

Find the Ship's position on the chart at the time of taking the second altitude ?

6. If at sea on April, 1876, P.M. and uncertain of my position, when a Chronometer shewed 10d 1h 17m 46s G.M.T. Supposed the observed altitude of the Sun's L.L. be $45^{\circ} 17' 15''$, and again P.M. the same day when the Chronometer shewed 10d 5h 9m 14s G.M.T., the observed altitude of

Sun's L.L. be $18^{\circ} 17'$. The Ship have made 12 miles on a true W $\frac{1}{2}$ N course in the interval. Height of the eye 27 feet. Required the line of bearing when the first altitude was taken, and the position of the ship by "Sumner's Method" when the second altitude was observed; assuming the latitude $51^{\circ} 10' N$ and $51^{\circ} 30' N$.

Again; suppose the Ship's positions at the time of taking the second altitude to be as follows:—

D.
Latitude $51^{\circ} 10' N$
Longitude $6 18 W$

E.
Latitude $51^{\circ} 30' N$
Longitude $6 18\frac{1}{2} W$

Find the Ship's position on the chart at the time of taking the second altitude?

7. If at sea, on May, 1876, A.M., and uncertain of my position; when a Chronometer showed 29d 19h 21m 19s G.M.T. Suppose the observed altitude of the Sun's L.L. be $23^{\circ} 42' 10''$, and again P.M. the same day when the Chronometer shewed 30d 2h 7m 9s G.M.T., the observed altitude of the Sun's L.L. be $56^{\circ} 45'$. The ship have made 67 miles on a true W. course in the interval. Height of the eye 15 feet. Required the line of bearing when the first altitude was taken, and the position of the Ship by "Sumner's Method" when the second altitude was observed; assuming the latitudes $50^{\circ} 0' N$ and $51^{\circ} 0' N$.

Again; suppose the Ship's positions at the time of taking the second altitude to be as follows:

D.
Latitude $50^{\circ} 0' N$
Longitude $10 20 W$

E.
Latitude $51^{\circ} 0' N$
Longitude $12 21\frac{1}{2} W$

Find the Ship's position on the chart at the time of taking the second altitude?

8. If at sea, on June 24th, 1876, A.M., and uncertain of my position, when a Chronometer showed 24d 0h 5m 54s G.M.T. Suppose the observed altitude of the Sun's L.L. $60^{\circ} 26' 15''$, and again P.M. the same day when the Chronometer shewed 24d 7h 19m 36s G.M.T. observed altitude of the Sun's L.L. be $12^{\circ} 57'$. The Ship have made 33 miles on a true E $\frac{1}{2}$ S course in the interval. Height of the eye 20 feet. Required the line of bearing when the first altitude was taken, and the position of the Ship by "Sumner's Method" when the second altitude was observed; assuming the latitudes $51^{\circ} 30' N$ and $51^{\circ} 38' N$.

Again; suppose the Ship's positions at the time of taking the second altitude to be as follows:

D.
Latitude $51^{\circ} 30' N$
Longitude $10 50\frac{1}{2} W$

E.
Latitude $51^{\circ} 38' N$
Longitude $10 45 W$

Find the Ship's position on the chart at the time of taking the second altitude?

9. If at sea on July, 1876, p.m. at Ship, and uncertain of my position, when a Chronometer showed 5d 1h 3m 59s G.M.T. Suppose the observed altitude of the Sun's L.L. be $61^{\circ} 16' 10''$, and again p.m. the same day when the Chronometer showed 5d 6h 17m 9s G.M.T., the observed altitude of the Sun's L.L. be $20^{\circ} 20'$. The Ship have made 18 miles on a true W by N $\frac{1}{2}$ N course in the interval. Height of the eye 24 feet. Required the line of bearing when the first altitude was taken, and the position of the Ship by "Sumner's Method" when the second altitude was observed; assuming the latitudes $50^{\circ} 40' N$ and $50^{\circ} 52' N$.

Again; suppose the Ship's positions at the time of taking the second altitude be as follows :

D.		E.	
Latitude	$50^{\circ} 40' N$	Latitude	$50^{\circ} 52' N$
Longitude	8 12 W	Longitude	8 8 W

Find the Ship's position on the chart at the time of taking the second altitude ?

10. If at Sea on August, 1876, A.M. at Ship, and uncertain of my position, when the Chronometer shewed 16d. 8h. 0m. 20s. Suppose the observed altitude of the Sun's L.L. be $28^{\circ} 14' 10''$, and again p.m. at Ship the same day when the Chronometer shewed 16d. 14h. 0m. 20s. G.M.T. the observed altitude of the Sun's L.L. be $46^{\circ} 21'$. The ship have made 30 miles on a true E. course in the interval. Height of the eye 12 feet. Required the line of bearing when the first altitude was taken, and the position of the Ship by "Sumner's Method" when the second altitude was observed; assuming the latitudes $50^{\circ} 10' N$. and $50^{\circ} 50' N$.

Again; suppose the Ship's positions at the time of taking the second altitude to be as follows :—

D.		E.	
Latitude	$50^{\circ} 10' N$	Latitude	$50^{\circ} 50' N$
Longitude	179 16 $\frac{1}{2}$ E	Longitude	178 5 E

Find the Ship's position on the chart at the time of taking the second altitude ?

11. If at Sea on September 14th, 1876, A.M., and uncertain of my position when a Chronometer shewed 18d 19h 4m 57s G.M.T. Suppose the observed altitude of the Sun's L.L. be $10^{\circ} 25' 10''$, and again p.m. the same day when the Chronometer showed 14d 8h 6m 50s G.M.T., the observed altitude of the Sun's L.L. be $80^{\circ} 24'$. The ship have made 32 miles on a true NE by E $\frac{1}{2}$ E course in the interval. Height of the eye 17 feet. Required the line of bearing when the first altitude was taken, and the position of the ship by "Sumner's Method" when the second altitude was observed; assuming the latitudes $49^{\circ} 30' N$ and $50^{\circ} 0' N$.

Again; suppose the Ship's computed positions at the time of taking the second altitude be as follows :

D.
Latitude $49^{\circ} 30' N$
Longitude $8^{\circ} 58' W$

E.
Latitude $50^{\circ} 0' N$
Longitude $4^{\circ} 82\frac{1}{2}' W$

Find the Ship's position on the chart at the time of taking the second altitude ?

12. If at sea on October 20th, 1876, p.m., and uncertain of my position, when a Chronometer showed 20d 0h 30m 54s G.M.T. Suppose the observed altitude of the Sun's L.L. be $29^{\circ} 37' 15''$, and again p.m. the same day when the Chronometer showed 20d 3h 44m 50s G.M.T., the observed altitude of the Sun's L.L. be $12^{\circ} 21'$. The Ship have made 24 miles on a true NNE $\frac{1}{2}$ E course in the interval. Height of the eye 20 feet. Required the line of bearing when the first altitude was taken, and the position of the Ship by Sumner's Method " when the second altitude was observed ; assuming the latitudes $49^{\circ} 20' N$ and $49^{\circ} 28' N$.

Again ; suppose the Ship's calculated positions at the time of taking the second altitude to be as follows :

D.
Latitude $49^{\circ} 20' N$
Longitude $8^{\circ} 47' W$

E.
Latitude $49^{\circ} 50' N$
Longitude $4^{\circ} 17\frac{1}{2}' W$

Find the Ship's position on the chart at the time of taking the second altitude ?

13. If at sea on November 23rd, 1876, a.m., and uncertain of my position, when a Chronometer showed 22d 20h 17m 28s G.M.T. Suppose the observed altitude of the Sun's U.L. be $6^{\circ} 14' 40''$, and again p.m. the same day, when the Chronometer showed 23d 1h 46m 40s G.M.T., the observed altitude of the Sun's U.L. be $14^{\circ} 58' 20''$. The Ship have made 5 miles on a true West course in the interval. Height of the eye 17 feet. Required the line of bearing when the first altitude was taken, and the position of the ship by " Sumner's Method " when the second altitude was observed ; assuming the latitudes $49^{\circ} 50' N$ and $50^{\circ} 20' N$.

Again: suppose the Ship's calculated positions at the time of taking the second altitude to be as follows :

D.
Latitude $49^{\circ} 50' N$
Longitude $0^{\circ} 48\frac{1}{2}' E$

E.
Latitude $50^{\circ} 20' N$
Longitude $0^{\circ} 41' W$

Find the Ship's position on the chart at the time of taking the second altitude ?

14. If at sea on December 5th, 1876, a.m., and uncertain of my position, when a Chronometer showed 4d 21h 10m 2s G.M.T. Suppose the observed altitude of the Sun's U.L. be $9^{\circ} 27' 7''$, and again p.m. the same day, when the Chronometer showed 5d 2h 5m 59s G.M.T., the observed altitude of the Sun's U.L. be $9^{\circ} 39' 0''$. The Ship have made 21 miles on a true WNW course in the interval. Height of the eye 19 feet. Required the line of bearing when the first altitude was taken, and the position of the ship by Sumner's Method " when the second altitude was observed ; assuming the latitudes $51^{\circ} 30' N$ and $52^{\circ} 0' N$.

Again; suppose the Ship's positions at the time of taking the second altitude be as follows :

D.
Latitude $51^{\circ} 30' N$
Longitude $3 16\frac{1}{4} E$

E.
Latitude $52^{\circ} 0' N$
Longitude $2 8\frac{1}{4} E$

Find the Ship's position on the chart at the time of taking the second altitude ?

15. If at sea on January 14th, 1876, A.M., at Ship, and uncertain of my position, when a Chronometer showed, January 14th, 11h 29m 0s G.M.T. Suppose the observed altitude of the Sun's L.L. be $18^{\circ} 53' 44''$, and again the same day when the Chronometer showed January 14th, 18h 12m 0s G.M.T., the observed altitude of the Sun's L.L. be $18^{\circ} 6' 51''$. The Ship have made 3 miles on a true North course in the interval. Height of the eye 19 feet. Required the line of bearing when the first altitude was taken, and the position of the Ship by "Sumner's Method" when the second altitude was observed ; assuming the latitudes $48^{\circ} 43' N$ and $49^{\circ} 30' N$.

Again; suppose the Ship's positions at the time of taking the second altitude as follows :

D.
Latitude $48^{\circ} 43' N$
Longitude $178 5 W$

E.
Latitude $49^{\circ} 30' N$
Longitude $177 28\frac{1}{4} E$

Find the Ship's position on the chart at the time of taking the second altitude ?

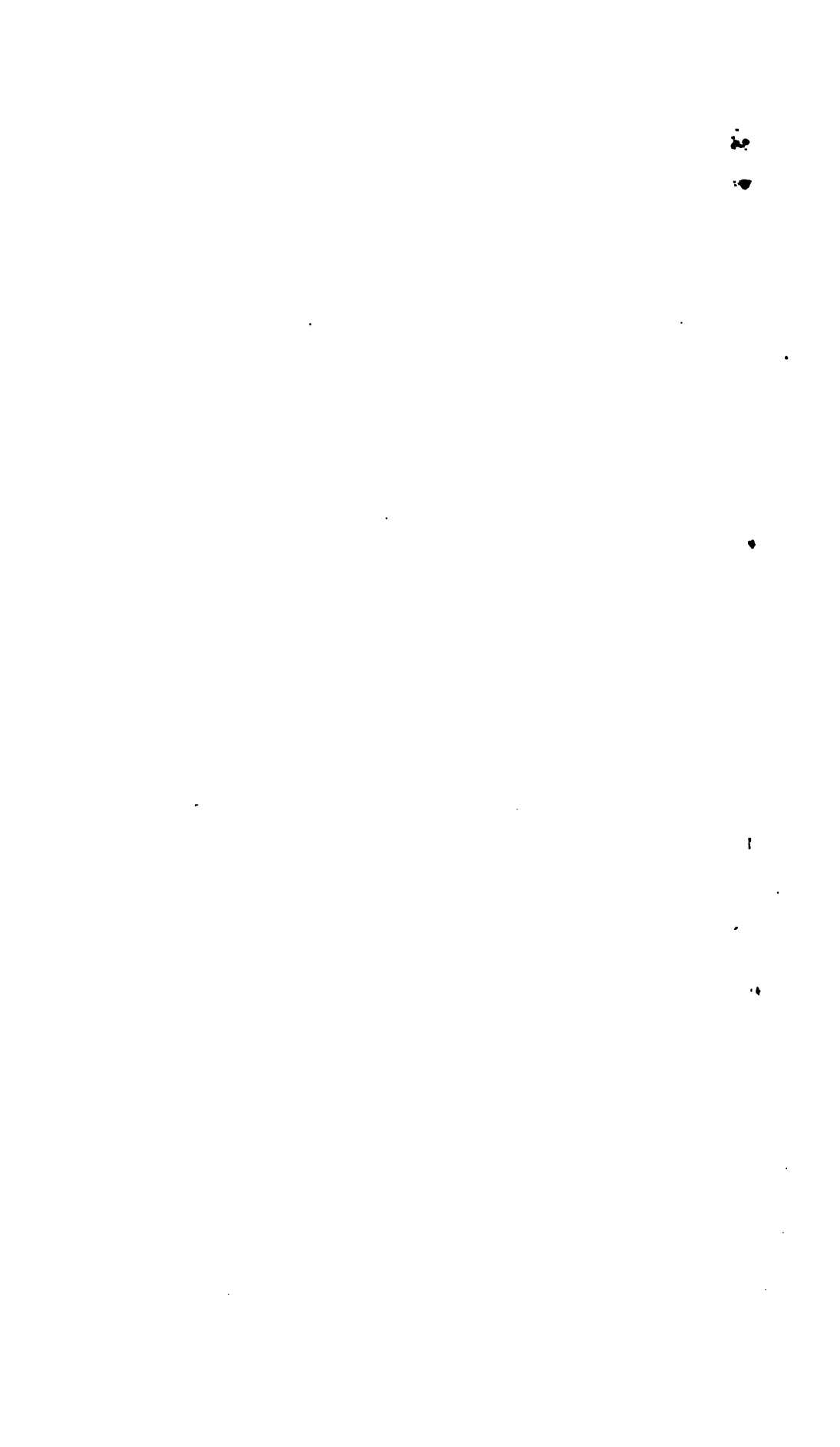
ANSWERS TO SUMNER'S METHOD.

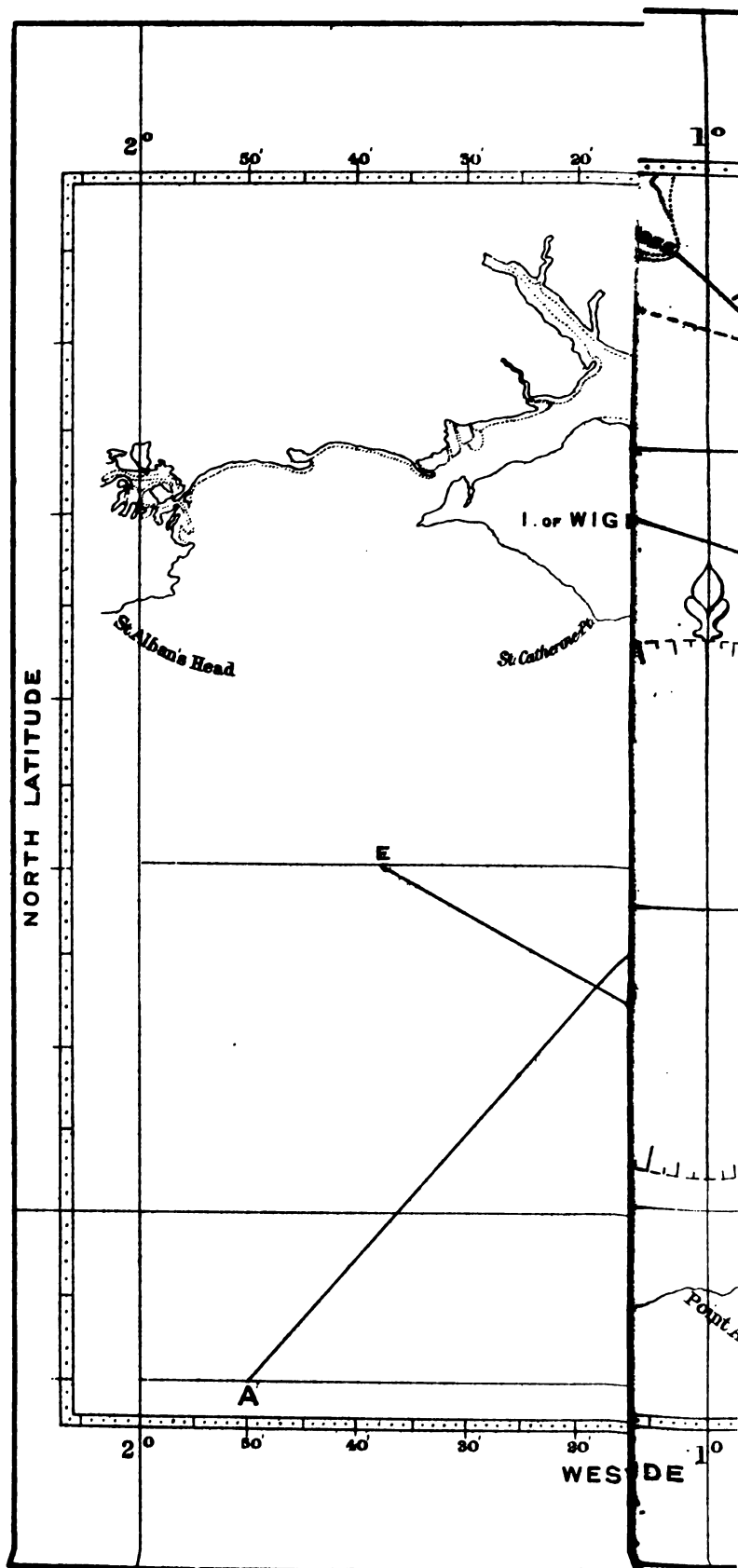
No.	Pol. Dist.	Eq. T.	True Alt.	W. Longitudes at		First Line of Bearing.		Degrees Sun's True Bearing.	Ship's position on Chart.	
				Lower Latitude.	Higher Latitude.	In Points.	In Degrees.		Lat. N	Long. W
1	92 4 19	m. s. + 9 5	14 22 33	5 35 1	5 12	N by E 2 E +	N 20 E	S 70 E	49 49	5 7 1
2	83 30 18	+ 2 27	45 18 8	7 22 1	9 21 3	W by N 1 N	N 56 W	S 34 W	50 53	7 31
3	111 43 38	+ 8 23	6 22 18	9 02 3	7 22 1	NE +	N 45 E	S 45 E	50 25	7 11
4	99 37 47	+ 13 31	15 23 28	6 55 1	6 20	NE 1 N	N 37 E	S 53 E	50 15 3	6 22
5	94 16 45	+ 10 37	22 37 10	6 15 1	5 34 1	NE 1 N	N 39 E	S 51 E	51 13 3	6 33 1
6	81 47 47	+ 1 11	45 27 15	4 53 1	6 25 1	W by N 2 N	N 70 W	S 20 W	51 25	6 17 1
7	68 9 25	- 2 42	23 52 6	9 26 1	9 36	N 1 W	N 6 W	S 84 W	50 28 3	11 19
8	66 31 55	+ 2 12	60 37 8	12 8 1	11 34 1	E by N 2 N	N 70 E 1	S 20 E	51 31	10 49 1
9	67 15 17	+ 4 21	61 26 39	7 14 E	8 32 E	W by N 1 N	N 76 W	S 14 W	50 48	8 9 1
10	76 32 19	+ 3 54	28 24 56	179 22 1 W	179 38 W	N by E	N 11 E	S 79 E	49 44	179 58
11	86 44 6	- 4 38	10 32 7	4 58 W	4 52	N 2 E	N 8 E	S 82 E	49 44	4 14
12	100 34 55	- 15 14	29 47 25	4 46 1 E	6 32 1 E	W 1 N	N 83 W	S 7 W	49 40	4 7 1
13	110 27 55	- 13 19	5 45 59	0 13 1 E	0 28 3	NE 1 N	N 42 E	S 48 W	50 2	0 0 E
14	112 27 19	- 9 1	9 0 57	2 36 1 E	3 47 1 W	NE by E	N 34 E	S 56 E	51 48	2 30 E
15	111 17 17	+ 9 22	19 3 5	177 11 E	15 175 15 30	E 1 N	N 80 E	S 10 E	49 3 1	180 0

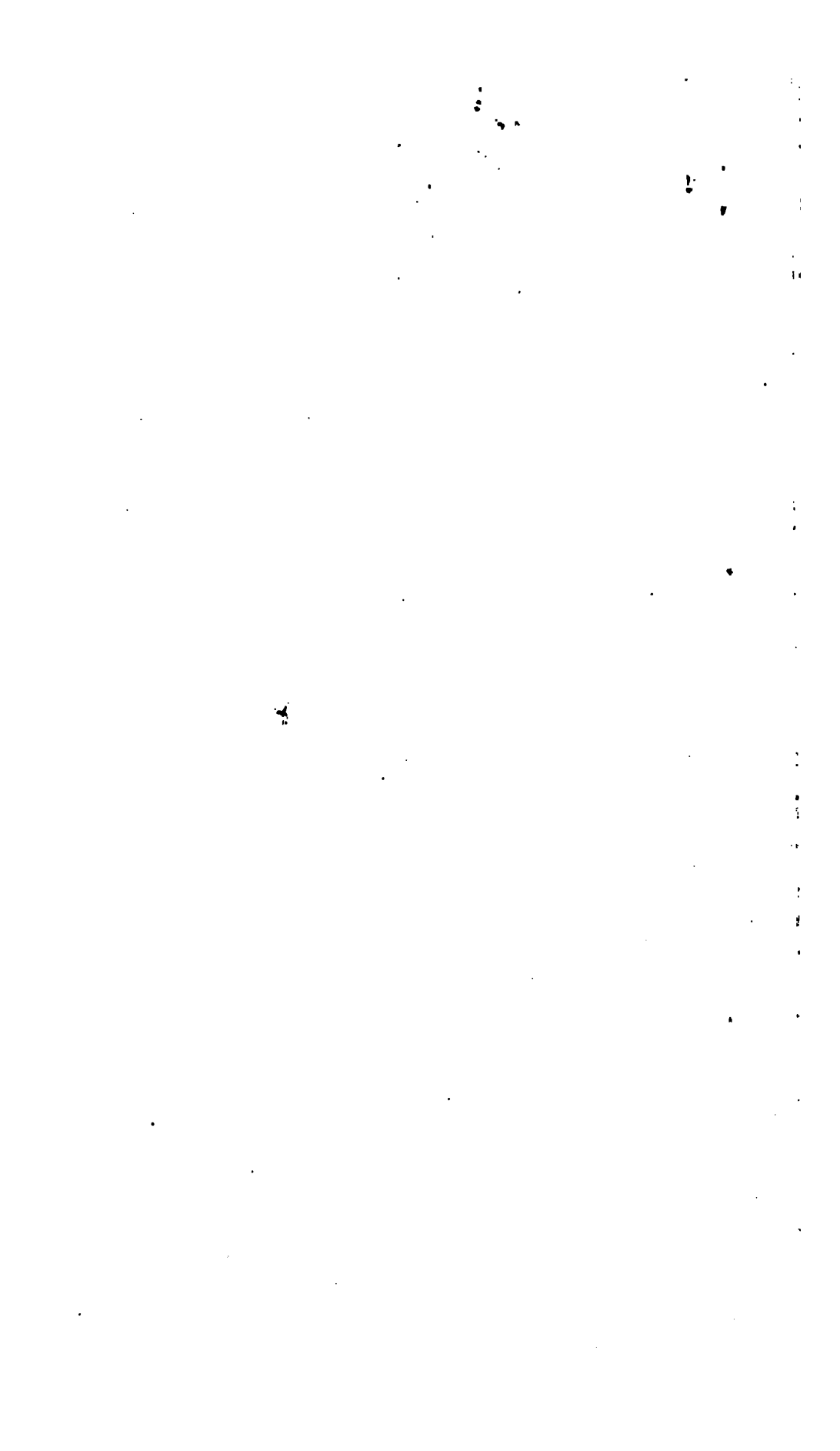
A TABLE OF THE ANGLES.

Which every point and eighth of a point makes with the meridian.

POINTS.	NO.	DEGREES, &c.	NO.	POINTS.
North.	0	0° 0' 0"	0	South.
	$\frac{1}{8}$	1 24 22	$\frac{1}{8}$	
	$\frac{1}{4}$	2 48 45	$\frac{1}{4}$	
	$\frac{3}{8}$	4 13 7	$\frac{3}{8}$	
	$\frac{1}{2}$	5 37 30	$\frac{1}{2}$	
	$\frac{5}{8}$	7 1 52	$\frac{5}{8}$	
	$\frac{3}{4}$	8 26 15	$\frac{3}{4}$	
	$\frac{7}{8}$	9 50 37	$\frac{7}{8}$	
N by E....N by W....	1	11 15 0	1	S by W.....S by E
	$\frac{1}{8}$	12 39 22	$\frac{1}{8}$	
	$\frac{1}{4}$	14 3 45	$\frac{1}{4}$	
	$\frac{3}{8}$	15 28 7	$\frac{3}{8}$	
	$\frac{1}{2}$	16 52 30	$\frac{1}{2}$	
	$\frac{5}{8}$	18 16 52	$\frac{5}{8}$	
	$\frac{3}{4}$	19 41 15	$\frac{3}{4}$	
	$\frac{7}{8}$	21 5 37	$\frac{7}{8}$	
NNE.... NNW.....	2	22 30 0	2	SSW.....SSE
	$\frac{1}{8}$	23 54 22	$\frac{1}{8}$	
	$\frac{1}{4}$	25 18 45	$\frac{1}{4}$	
	$\frac{3}{8}$	26 43 7	$\frac{3}{8}$	
	$\frac{1}{2}$	28 7 30	$\frac{1}{2}$	
	$\frac{5}{8}$	29 31 52	$\frac{5}{8}$	
	$\frac{3}{4}$	30 56 15	$\frac{3}{4}$	
	$\frac{7}{8}$	32 20 37	$\frac{7}{8}$	
NE by N..NW by N ..	3	33 45 0	3	SW by S.....SE by S
	$\frac{1}{8}$	35 9 22	$\frac{1}{8}$	
	$\frac{1}{4}$	36 33 45	$\frac{1}{4}$	
	$\frac{3}{8}$	37 58 7	$\frac{3}{8}$	
	$\frac{1}{2}$	39 22 30	$\frac{1}{2}$	
	$\frac{5}{8}$	40 46 52	$\frac{5}{8}$	
	$\frac{3}{4}$	42 11 15	$\frac{3}{4}$	
	$\frac{7}{8}$	43 35 37	$\frac{7}{8}$	
NE..... NW.....	4	45 0 0	4	SW.....SE
	$\frac{1}{8}$	46 24 22	$\frac{1}{8}$	
	$\frac{1}{4}$	47 48 45	$\frac{1}{4}$	
	$\frac{3}{8}$	49 13 7	$\frac{3}{8}$	
	$\frac{1}{2}$	50 37 30	$\frac{1}{2}$	
	$\frac{5}{8}$	52 1 52	$\frac{5}{8}$	
	$\frac{3}{4}$	53 26 15	$\frac{3}{4}$	
	$\frac{7}{8}$	54 50 37	$\frac{7}{8}$	
NE by E..NW by W ..	5	56 15 0	5	SW by W....SE by E
	$\frac{1}{8}$	57 39 22	$\frac{1}{8}$	
	$\frac{1}{4}$	59 3 45	$\frac{1}{4}$	
	$\frac{3}{8}$	60 28 7	$\frac{3}{8}$	
	$\frac{1}{2}$	61 52 30	$\frac{1}{2}$	
	$\frac{5}{8}$	63 16 52	$\frac{5}{8}$	
	$\frac{3}{4}$	64 41 15	$\frac{3}{4}$	
	$\frac{7}{8}$	66 5 37	$\frac{7}{8}$	
ENE .....WNW	6	67 30 0	6	WSW..... ESE
	$\frac{1}{8}$	68 54 22	$\frac{1}{8}$	
	$\frac{1}{4}$	70 18 45	$\frac{1}{4}$	
	$\frac{3}{8}$	71 43 7	$\frac{3}{8}$	
	$\frac{1}{2}$	73 7 30	$\frac{1}{2}$	
	$\frac{5}{8}$	74 31 52	$\frac{5}{8}$	
	$\frac{3}{4}$	75 56 15	$\frac{3}{4}$	
	$\frac{7}{8}$	77 20 37	$\frac{7}{8}$	
E by N....W by N....	7	78 45 0	7	W by S.....E by S
	$\frac{1}{8}$	80 9 22	$\frac{1}{8}$	
	$\frac{1}{4}$	81 33 45	$\frac{1}{4}$	
	$\frac{3}{8}$	82 58 7	$\frac{3}{8}$	
	$\frac{1}{2}$	84 22 30	$\frac{1}{2}$	
	$\frac{5}{8}$	85 46 52	$\frac{5}{8}$	
	$\frac{3}{4}$	87 11 15	$\frac{3}{4}$	
	$\frac{7}{8}$	88 35 37	$\frac{7}{8}$	
East .....West..	8	90 0 0	8	West.....East







SUPPLEMENT TO NAVIGATION.

PRACTICAL EXAMINATION IN THE USE

OF THE

BLANK CHART

FOR ALL GRADES WHERE THE CHART IS USED.

DEVIATION CARD, No. 1.

SHIP'S HEAD WHEN BUILDING.

Ship's Head. Correct Magnetic.	Deviations.	Ship's Head by Compass.	Deviations.
North	2 East	North	2 East
N by E.....	6	N by E.....	10
NNE.....	10	NNE.....	16
NE by N	15	NE by N	22
NE	20	NE	24
NE by E	22	NE by E	25
ENE.....	24	ENE.....	24
E by N.....	25	E by N.....	22
East	25	East	20
E by S	23	E by S	16
ESE	19	ESE	15
SE by E	14	SE by E	9
SE	9	SE	6
SE by S	8	SE by S	2
SSE	8 West	SSE	2 West
S by E	4	S by E	8
South	6	South	5
S by W.....	7	S by W.....	6
SSW	9	SSW	7
SW by S	11	SW by S	9
SW	12	SW	10
SW by W.....	14	SW by W.....	12
WSW	17	WSW	14
W by S.....	19	W by S.....	15
West.....	20	West.....	18
W by N	21	W by N	20
WNW	20	WNW	21
NW by W	18	NW by W	21
NW	16	NW	20
NW by N.....	12	NW by N.....	17
NNW	8	NNW	12
N by W	4	N by W	6

Exn. 9 C.

Rotation No.

224

Port of Sunderland.

EXAMINATION IN CHART

FOR ALL GRADES WHERE THE CHART IS USED.

The Candidate will be required to work out the following questions on either a true or magnetic chart, whichever may be handed to him by the Examiner; and also determine whether the chart is a true or magnetic one, and whether it is for the northern or southern, and eastern or western Hemisphere.

EXAMPLE I.

(1.) Using deviation card No.....find the course to steer by compass from Boulogne Light to the Royal Sovereign Shoal Light, also the distance.

Answer.—Compass Course $N 51^{\circ} 37' = NW \frac{1}{2} W$. Distance $4\frac{1}{2}$ miles. Variation $19^{\circ} 25' W$. Deviation $20^{\circ} 22' W$.

(2.) With the ship's head on the above-named compass course, a (Lighthouse) Dungeness, bore by compass North, and Boulogne bore $S 52^{\circ} E$ by the same compass, find the ship's position.

Answer.—Latitude $50^{\circ} 44\frac{1}{2}' N$. Longitude $1^{\circ} 18' E$.

(8.) With the ship's head as above, a (Lighthouse) Beachy Head bore by compass $N 14^{\circ} W$, and after continuing on the same course 15 miles, it bore $N 68^{\circ} E$, find the position of ship, and her distance from Beachy Head at the time of taking the second bearing.

Answer.—Latitude $50^{\circ} 36' N$. Longitude $0^{\circ} 6' E$. Distance $9\frac{1}{2}$ miles.

All the foregoing questions must be answered, but this does not preclude the examiner from putting any other questions of a practical character or which the local circumstances of the port may require.

(Signature) Wm. C. BERGEN,

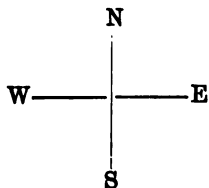
Date 9th June, 1881,

Chart used English Channel.

EXAMINATION IN CHART.

Solution of the preceding Questions.

(1.) Lay the edge of a parallel ruler over Boulogne Light and the Royal Sovereign Shoal Light, then move the ruler parallel to the line through them until an edge pass through the centre of the true compass, the point of the compass coinciding with the edge of the ruler shews the true course from Boulogne to the Shoal to be $W \frac{1}{4} S$, and by applying a pair of dividers to the space between them and then to the latitude scale at the side of the chart the distance is found to be 44 miles; then proceed as follows:



By the true Chart; to points, Degrees and Minutes.

True course from Boulogne to Shoal $W \frac{1}{4} S = S 88^{\circ} 36' W$

Variation; from chart

19 25 W allow to right hand

$$\begin{array}{r} S 108 \quad 1 W \\ 180 \quad 0 \\ \hline \end{array}$$

Magnetic course

$W \text{ by } N \frac{1}{4} N = N 71^{\circ} 59' W$

Deviation, from left side of card

20 22 W allow to right hand

Compass course

$$\begin{array}{r} NW \frac{1}{4} W = N 51^{\circ} 37' W \\ \hline \end{array}$$

To find the Deviation for $W \text{ by } N \frac{1}{4} N$.

Ship's Head. Deviation.

W by N

21°

21° 0'

WNW

20

— 38

—

1

20 22 Deviation due to W by N $\frac{1}{4} N$.

60

—

8)60 difference in minutes

—

7·5

difference due to $\frac{1}{4}$ point

5

—

87·5

difference due to $\frac{3}{4}$ point

Note. It is in general sufficiently near the truth to work to the nearest degree, as follows:

By the Magnetic Chart, to Points and Degrees.

Find the magnetic course with the parallel ruler and magnetic compass in the same manner as in finding the true course.

Magnetic course from Boulogne to Shoal W by N $\frac{1}{4}$ N	= N 72° W
Deviation	20 W to right
Compass course	NW $\frac{1}{4}$ W = <u>N 52° W</u>

Notes. It sometimes happens that the course is between two courses on the middle line, and that there is a considerable difference in the deviations of the two adjoining courses.

Thus, suppose that for the course NE the deviation is 2°E, and for the course NE by E it is 10°W, and that it is required for the course NE $\frac{1}{4}$ E, then proceed to find the difference of deviations for every $\frac{1}{4}$ point, and thence the deviation for NE $\frac{1}{4}$ E as follows.

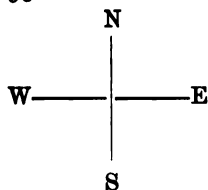
Ship's Head	Deviations.	
NE	2°E	
NE $\frac{1}{4}$ E	$\left. \begin{array}{l} \text{Add } 8^\circ \text{ dev.} \\ \text{for each} \\ \frac{1}{4} \text{ point.} \end{array} \right\}$	1 W
NE $\frac{1}{2}$ E		4 W
NE $\frac{3}{4}$ E		7 W
NE by E		10 W
Difference of deviation	4)12 for 1 point	
	<u>8</u> „ $\frac{1}{4}$ „	

Thus the deviation for the ship's head NE $\frac{1}{4}$ E is 7°W, or by taking 8° from 10°W, the deviation for NE $\frac{1}{4}$ E is 7°W.

It often happens that the deviation due to an intermediate course can be seen at once by inspection.

Thus in question (4), in this example, the deviation is required for NW $\frac{1}{4}$ W and by the Table.

The deviation for ship's head NW	= 16°W
„ „ NW by W	= 18 W
And it is evident that for ship's head NW $\frac{1}{4}$ W	= 17 W



(2.) *By True Chart, to Points, Degrees and Minutes.*

Compass bearings, Dungeness North	= N 0° 0' W	Boulogne SE $\frac{5}{8}$ E	= S 52° 2' E
Deviation same as in (1)	20 22 W	Allow to left	20 22 W
Magnetic bearings	N by W $\frac{1}{4}$ W = N 20 22 W	E by S $\frac{5}{8}$ S	= S 72 24 E
Variation same as in (1)	19 25 W	Allow to left	19 25 W
True bearings	NW $\frac{1}{4}$ N = N 89 47 W		S 91 49 E
			180 0
			E $\frac{1}{8}$ N 88 11 E

By Magnetic Chart, to Points and Degrees.

Compass bearings Dungeness North	= N 0° W	Boulogne SE $\frac{5}{8}$ E	= S 52° E
Deviation same as in (1)	20 W	to left	20 W
Magnetic bearings	N by W $\frac{1}{4}$ W = N 20 W	E by S $\frac{5}{8}$ S	= S 72 E

Draw a line through Dungeness bearing N by W $\frac{1}{4}$ W magnetic, or NW $\frac{1}{4}$ N true, and another through Boulogne bearing E by S $\frac{5}{8}$ S magnetic, or E $\frac{1}{8}$ N true, the point where they meet is the position of the ship on the chart, and it is in Latitude 50° 44' N, Longitude 1° 18' E.

(8.) *By True Chart, to Degrees and Points.*

Beachy Head bore by compass	N 14° W,	and afterwards N 68° E
Deviation same as in (1)	20 W	to left 20 W
Magnetic bearings	NW by N = N 84 W	NE $\frac{1}{4}$ E 48
Variation same as in (1)	19 W	to left 19
True bearings	NW $\frac{3}{4}$ W = N 53 W	NNE $\frac{1}{4}$ E = N 29 E

By Magnetic Chart, to Degrees and Points.

Beachy Head bore by compass	N 14° W	Afterwards N 68° E
Deviation same as in (1)	20 W	to left 20 W
Magnetic Bearings	NW by N = N 84 W	NE $\frac{1}{4}$ E = N 48 E

Draw a line O M, through Beachy Head, bearing NW by N magnetic, or NW $\frac{3}{4}$ W true, and another, O N, bearing NE $\frac{1}{4}$ E magnetic, or NNE $\frac{1}{4}$ E true, take 15 miles in the dividers, from the latitude scale at the side of the chart, and move a parallel ruler parallel to the course from Boulogne to the Royal Sovereign Shoal, until the dividers reach from M to N; then N is the position of the ship, and she is 9 miles distance from Beachy Head, and in Latitude 50° 87' N, Longitude 0° 6' E.

Exn. 9 D.

Rotation No.

Port of

EXAMINATION IN CHART.

ADDITIONAL FOR MASTERS.

(4.) Find the course to steer by compass from Boulogne to Royal Sovereign Shoal (see question 1) to counteract the effect of a current which set WSW magnetic, at the rate of 2 miles per hour, the ship making by log 4 miles per hour, also the distance the ship would then make good per hour towards the Shoal.

Answer.—Compass course N 84° W. Distance $5\frac{1}{2}$ miles.

Set of current, or tide, WSW magnetic = S 67° 30'WW

Variation from chart 19 25 W Allow to lef

Set of current, true S 48 5 W = SW $\frac{1}{2}$ W

Let A, on the chart, be the point from which the ship starts, and that she is bound along the line AC; as the scale of the chart is too small for this problem, and the longitude scale is one of equal parts, take 10 miles on it, to represent 1 mile in this problem; set off 2 miles, the rate of the tide, that is 20 miles on the longitude scale, from A to B, WSW magnetic, or SW $\frac{1}{2}$ W true; then take 4 miles, the rate of the ship, that is 40 miles on the scale, set one foot of the dividers on the point B, and let the other foot meet the line AC in the point C, join BC.

Then the direction of BC represents the course the ship must steer, to counteract the effect of the current, and the line AC represents the distance the ship would make good in an hour.

By the true compass the course from B to C is W by N $\frac{1}{4}$ N

True course W by N $\frac{1}{4}$ N = N 70° W

Variation 19 W Allow to right

Magnetic course N 51° W = NW $\frac{1}{4}$ W

Deviation for ship's head NW $\frac{1}{4}$ W 17 W Allow to right

Compass course N 84° W = NW by N

And by the scale the distance is $52\frac{1}{2}$ miles, that is the distance made good per hour is $5\frac{1}{2}$ miles.

Note. If the dotted line AD be drawn parallel to BC, and CD parallel to BA, then the ship's head is always in the direction of AD, but she is always on the line AC; the candidate will not be required to draw the lines AD, DC.

(5.) On January 18th at 6h 0m A.M., being off Shoreham by reckoning, took a cast of the lead, required the correction to be applied to the depth obtained by the lead line before comparing it with the depth marked on the chart.

	d.	h.	m.		ft.	in.
Time of H.W. at Dover, Jan.	12	11	39	P.M.	Height of tide at Dover	19 1
Constant for Shoreham	+	0	22		Constant for Shoreham	—1 2
Time of H.W. at Shoreham	18	0	1	A.M.	Height of tide Shoreham	17 11
M.T.S.	18	6	0	A.M.	Mean Spring range	9 0
Time after H.W. at Shoreham		5	59		Below mean level	8 11

	ft.	in.
Half mean spring range at Shoreham	9	0
Table B.	—8	11
Correction to be subtracted	0	1

See page 226 Tide Table.

from depth by lead

(See Bergen's Navigation page 238.)

(6.) What do you understand the small numbers to indicate that you see placed about the chart, and at what time of tide?

A. Depth of water in fathoms, sometimes in feet. At low water ordinary springs.

(7.) What do the Roman numerals indicate that are occasionally seen near the coasts and in harbours?

The time of high water at that place, at full and change of the moon.

(8.) How would you find, approximately, the time of high water at any place, the Admiralty tables not being at hand, nor any other special tables available?

To the time of high water at full and change I would add 49 minutes for every day that has elapsed since the full or change of the moon; or to the time of the moon's meridian passage, corrected for longitude, add the port establishment, the sum, in either case, would be the P.M. tide required.

All the foregoing questions, and those on Form Exn. 9 C., must be answered, but this does not preclude the examiner from putting any other questions of a practical character or which the local circumstances of the port may require.

Signature.....

Date.....

Exn. 9 C.

Port of Sunderland.

Rotation No.

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EXAMINATION IN CHART.

EXAMPLE II.

FOR ALL GRADES WHERE THE CHART IS USED.

The Candidate will be required to work out the following questions on either a true or magnetic chart, whichever may be handed to him by the Examiner; and also to determine whether the chart is a true or magnetic one, and whether it is for the Northern or Southern, or Eastern or Western Hemisphere.

(1.) Using a deviation card No.....find the course to steer by compass from Kelp Island to the Wolf Rock; and also the distance?

Answer.—Compass course NNE $\frac{1}{4}$ E.

Distance 19 $\frac{1}{4}$ miles

Variation 15° 30'E

Deviation 20° 45'E

(2.) With the ship's head on the above named compass course, Point Pleasant bore by compass W by N $\frac{1}{4}$ N, and Beach Point bore N $\frac{1}{4}$ E by the same compass; find the ship's position?

Answer.—Latitude 51° 51'S

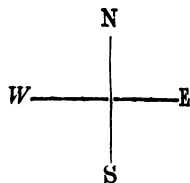
Longitude 58 7 W

(3.) With the ship's head as above Cape Pembroke bore by compass N by E $\frac{1}{4}$ E, and after continuing on the same course 14 miles it bore W by N $\frac{1}{4}$ N; find the position of the ship, and her distance from Cape Pembroke at the time of taking the second bearing?

Answer.—Latitude 51° 48'S

Longitude 57 37 $\frac{1}{4}$ W

Distance 8 $\frac{1}{4}$ Miles.

Solution of the preceding Questions.*(1). By True Chart, to Points and Degrees.**Kelp Point to Wolf Rock.*

True course NE by E $\frac{1}{4}$ E = N 65° E
 Variation from Chart 16 E, Allow to left hand

 Magnetic course NE $\frac{3}{8}$ E = N 49° E
 Dev. from left side of Card 21 E to left.

 Compass course NNE $\frac{1}{4}$ E = N 28° E

By Magnetic Chart, to Points and Degrees.

Magnetic course NE $\frac{3}{8}$ E = N 49° E
 Deviation 21 E Allow to left

 Compass course NNE $\frac{1}{4}$ E = N 28° E

(2.) By True Chart, to Points and Degrees.

<i>Point Pleasant.</i>	<i>Beach Point.</i>
Compass bearing W by N $\frac{1}{4}$ N = N 70° W	N $\frac{1}{4}$ E = N 8° E
Deviation same as in (1) 21 E	To right 21 E
Magnetic bearing NW $\frac{3}{8}$ W = N 49° W	NNE $\frac{1}{8}$ E = N 24° E
Variation same as in (1) 16 E	To right 16 E
True bearings NNW $\frac{7}{8}$ W = N 33° W	NE $\frac{1}{4}$ N = N 40° E

By Magnetic Chart, to Points and Degrees.

<i>Point Pleasant.</i>	<i>Beach Point.</i>
Compass bearing W by N $\frac{1}{4}$ N = N 70° W	N $\frac{1}{4}$ E = N 8° E
Deviation same as in (1) 21 E	To right 21 E
Magnetic bearings NW $\frac{3}{8}$ W = N 49° W	NNE $\frac{1}{8}$ E = N 24° E

*(3.) By True Chart, to Degrees and Points.**Pembroke Light.*

Compass bearings N by E $\frac{1}{4}$ E = N 17° E and W by N $\frac{1}{4}$ N = N 76° W	
Deviation same as in (1) 21 E	to right 21 E
Magnetic bearings NE $\frac{1}{4}$ N = N 38° E	NW $\frac{7}{8}$ W = N 55° W
Variation same as in (1) 16 E	to right 16 E
True bearings NE $\frac{1}{4}$ E = N 54° E	NW $\frac{1}{4}$ N = N 39° W

Exn. 9 D.

Port of Sunderland.

Rotation No.

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EXAMINATION IN CHART.

(4.) Find the course to steer by compass from Kelp Island to the Wolf Rock, (see question 1) to counteract the effect of a current which set magnetic ENE, or true $E \frac{1}{2} N$, at the rate of 8 miles per hour, the ship making by log 10 miles per hour; also the distance the ship would make good per hour towards the Light?

Answer.—Compass course NNE
Distance 18 miles nearly.

For the sake of keeping the lines clear of each other, let A represent the point from which the Ship starts; draw AC parallel to the course from Kelp to Wolf Rock, and AB, ENE magnetic, or $E \frac{1}{2} N$ true, 8 miles; with the dividers extended to 10 miles, set one foot at the point B and let the other meet the line AC in C, join AC; then

By the True Chart, to Points, Degrees and Minutes.

True course from B to C	$NE \frac{1}{2} E$	=	$N 54^{\circ} 51' E$
Variation			$15 \ 30 E$, to left
Magnetic course	$NE \frac{1}{2} N$	=	$N 89 \ 21 E$
			$17 \ 30 E$, to left
Compass course	NNE	=	$N 21 \ 51 E$

To Find the Deviation.

Ship's head magnetic.	Dev.	
NE	20	$20 \ 0$
NE by N	15	$-2 \ 30$
	$2)5$	$17 \ 30$ Dev. for $NE \frac{1}{2} N$
	$2 \ 30$	

By the Magnetic Chart, to Points and Degrees.

Magnetic course from B to C	$NE \frac{1}{2} N$	=	$N 89^{\circ}$
Deviation			18
Compass course	N by $E \frac{1}{2} E$	=	21

EXAMINATION IN CHART.

FOR ALL GRADES WHERE THE CHART IS USED.

EXAMPLE III.

(1.) Using deviation card No..... find the course to steer by compass from Cape Grisnez to Dover Pier End, also the distance.

Answer.—Compass course N $10^{\circ} 49' W$, or N by W
 Distance $27\frac{1}{2}$ miles
 Variation $18^{\circ} 20' W$
 Deviation 6 0 W

(2.) With the ship's head on the above-named compass course the South Sand Head Light Ship bore by compass NE by E $\frac{1}{2}$ E, and Dover Pier End bore N by W $\frac{3}{4}$ W by the same compass; find the ship's position.

Answer.—Latitude $51^{\circ} 4\frac{1}{2}' N$
 Longitude $1^{\circ} 22\frac{1}{2}' E$

(3.) With the ship's head as above the Varne Light Ship bore by compass NW by W $\frac{1}{2}$ W, and after continuing on the same course $10\frac{1}{2}$ miles it bore NW $\frac{1}{2}$ W; find the position of the ship, and her distance from Dover Pier End at the time of taking the second bearing?

Answer.—Latitude $51^{\circ} 4' N$
 Longitude $1^{\circ} 23\frac{1}{2}' E$
 Distance $3\frac{1}{2}$ miles.

SOLUTIONS OF THE PRECEDING QUESTIONS.

(1.) By True Chart, to Points, Degrees and Minutes.

True course NW by N $\frac{1}{4}$ N = N $35^{\circ} 9' W$
 Variation from chart 18 20 W Allow to right hand

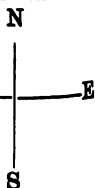
Mag. course N by W $\frac{1}{2}$ W = N $16^{\circ} 49' W$
 Deviation from left side of card 6 0 W Allow to right hand

Compass course N by W = N $10^{\circ} 49' W$

By Magnetic Chart, to Points and Degrees.

Magnetic course N by W $\frac{1}{2}$ W = N $17^{\circ} W$
 Deviation from left side 6 W to right

Compass course N by W = N $11^{\circ} W$



(2.) *By True Chart, to Points, Degrees and Minutes.*

South Sand Head Light Ship		Dover Pier End	
Compass course	N by E $\frac{1}{4}$ E = N 61° 53' E;	N by W $\frac{3}{4}$ W = N 18° 17' W	
Deviation same as in (1)	6 0 W; to left	6 0	
Magnetic courses	NE by E = N 55 53 E	NNW $\frac{1}{8}$ W = N 24 17 W	
Variation same as in (1)	18 20 W; to left	18 20 W	
True courses	NE $\frac{3}{8}$ N = N 37 33 E	NW $\frac{1}{4}$ N = N 42 37 W	

By Magnetic Chart, to Points and Degrees.

Compass courses	NE by E $\frac{1}{4}$ E = N 62° E;	N by W $\frac{3}{4}$ W = N 18° W	
Deviation same as in (1)	6 W; to left	6	
Magnetic course	NE by E = N 56 E	NNW $\frac{1}{8}$ W = N 24 W	

Latitude 51° 4 $\frac{1}{2}$ ' N. Longitude 1° 22 $\frac{1}{4}$ ' E.*By True Chart to Points, Degrees and Minutes.*(3.) *Varne Light Ship.*

Compass bearings	NW by W $\frac{1}{4}$ W = N 61° 53' W;	SW $\frac{1}{4}$ W = S 50° 38' W	
Deviation same as in (1)	6 0 W to left	6 0 W	
Magnetic bearings	WNW = N 67 53 W;	SW = S 44 38 W	
Variation same as in (1)	18 20 W to left	18 20 W	
True bearings	W $\frac{3}{8}$ N = N 86 13 W	SSW $\frac{3}{8}$ W = S 26 13 W	

By Magnetic Chart, to Points and Degrees.

Compass bearing	NW by W $\frac{1}{4}$ W = N 62 W;	SW $\frac{1}{4}$ W = S 51° W	
Deviation same as in (1)	6 W; to left	6 W	
Magnetic bearings	WNW = N 68 W	SW = S 45 W	

Exn. 9 D.

Rotation No.

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Port of

EXAMINATION IN CHART.

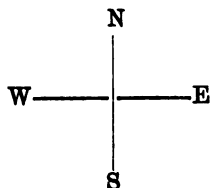
ADDITIONAL FOR MASTERS.

(4.) Find the course to steer by compass from Cape Grisnez to Dover (see question 1) to counteract the effect of a current which set ENE magnetic, or NE $\frac{3}{4}$ E true, 3 miles per hour, the ship making by log 10 miles per hour, also the distance the ship would then make good per hour towards Dover?

SOLUTION OF THE PRECEDING QUESTION.

Set off 3 miles, the rate of the tide taken from the scale, from A to B, NE $\frac{3}{4}$ E true, or ENE magnetic, then take 10 miles, the rate of the ship, with the dividers from the same scale, set one foot of the dividers on the point B, and let the other foot meet the line AC in the point C; join BC.

Then BC represents the course the ship must steer to counteract the tide, and AC represents the distance the ship would make good towards Dover in an hour.

*By the true Chart; to Points, Degrees and Minutes.*

True course from B to C is	N W $\frac{3}{4}$ W = N 52° 2' W
Variation; from chart	18 20 W to right
Magnetic course	NW by N = N 88 42 W
Deviation, for NW by N	12 0 W to right
Compass course	N by W $\frac{3}{4}$ W = N 21 42 W

By the Magnetic Chart, to Points and Degrees.

Magnetic course from B to C, NW by N	= N 84° W
Deviation from NW by N	12 W to right
Compass course NNW	= N 22 W

And by applying AC to the scale with the dividers, the distance made good towards Dover is 9 $\frac{1}{4}$ miles per hour.

Exn. 9 C.

Port of Sunderland.

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EXAMINATION IN CHART.

EXAMPLE IV.

FOR ALL GRADES WHERE THE CHART IS USED.

(1.) Using deviation card No..... find the course to steer by compass from Dungeness to the Cape Alprech; and also the distance?

Answer.—Compass course SE $\frac{3}{8}$ E. or S $49^{\circ} 38'E$

Distance 27 miles

Variation $18^{\circ} 25' W$

Deviation 7 30 E

(2.) With the ship's head on the above named compass course, Grisnez bore E by N $\frac{5}{8}$ N, and the Varne bore N $\frac{1}{8}$ W by the same compass; find the ship's position?

Answer.—Latitude $50^{\circ} 46\frac{1}{4}' N$

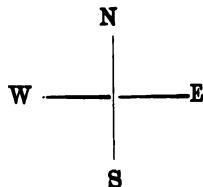
Longitude 1 $20\frac{1}{4} E$

(8.) With the ship's head as above, the Varne bore E $\frac{1}{8}$ N, and after continuing on the same course 11 miles it bore N by E $\frac{7}{8} E$; find the position of the ship, and her distance from the Varne at the time of taking the second bearing?

Answer.—Latitude $50^{\circ} 48\frac{3}{4}' N$

Longitude 1 $14\frac{1}{4} E$

Distance $7\frac{1}{2}$ miles.

Solution of the preceding Questions.(1.) *By True Chart, to Points, Degrees and Minutes.**Dungeness to Cape Alprech.*True course SE by E $\frac{3}{4}$ E = S $60^{\circ} 28'$ EVariation from chart $18 \ 25$ W, to rightMagnetic course SE $\frac{1}{4}$ S = S $42 \ 8$ EDev. from left side of Card $7 \ 80$ E to leftCompass course SE $\frac{1}{8}$ E = S $49 \ 38$ E*To find Deviation for SE $\frac{1}{4}$ S.*

Course.	Deviation.	
SE	9° E	$9^{\circ} \ 0' \text{ E}$
SE by S	8	$-1 \ 80$
	<u>4)6</u>	<u>7 \ 80 \text{ E}</u>
	1 80	

*By Magnetic Chart, to Points and Degrees.*Magnetic course SE $\frac{1}{4}$ S = S 42° EDeviation 8 E to leftCompass course SE $\frac{1}{8}$ E = S 50 E(2.) *By the True Chart, to Points, Degrees and Minutes.*

Cape Grisnez.		Varne.
Compass bearing E by N $\frac{5}{8}$ N = N $71^{\circ} 48'$ E,		N $\frac{1}{8}$ W = N $1^{\circ} 24'$ W
Deviation same as in (1) $7 \ 80$ E		To right $7 \ 80$ E
Magnetic bearing E by N = N $79 \ 18$ E		N $\frac{1}{4}$ E = N $6 \ 6$ E
Variation same as in (1) $18 \ 25$ W		To left $18 \ 25$ W
True bearings NE by E $\frac{3}{8}$ E = N $60 \ 48$ E		N by W $\frac{1}{8}$ W = N $12 \ 19$ W

*By Magnetic Chart, to Points and Degrees.*Compass bearing E by N $\frac{5}{8}$ N = N 72° EDeviation same as in (1) 8 E to rightMag. Bearings E $\frac{1}{8}$ N = N 80 EN $\frac{1}{8}$ W = N 1° W 8 EN $\frac{1}{4}$ E = N 7 E

(8.) *By the True Chart, to Points, Degrees and Minutes.*

Varne Compass bearings	$E \frac{1}{8} N = N 88^{\circ} 36' E$,	and N by	$E \frac{7}{8} E = N 21^{\circ} 6' E$
Deviation same as in (1)	<u>7 30 E</u>	to right	<u>7 30 E</u>
	N 96 6 E		NNE $\frac{1}{8} E = N 28 36 E$
Variation same as in (1)	<u>18 25 W</u>	to left	<u>18 25 W</u>
True bearings	E by N $\frac{1}{8} N = N 77 41 E$		N $\frac{7}{8} E = N 10 11 E$

By Magnetic Chart, to Points and Degrees.

Varne compass bearings	$E \frac{1}{8} N = N 89^{\circ} E$,	and N by	$E \frac{7}{8} E = N 21^{\circ} E$
Deviation same as in (1)	<u>8 E</u>	to right	<u>8 E</u>
	N 97 E		NNE $\frac{1}{8} E = N 29 E$
	<u>180</u>		<u>—</u>
Magnetic Bearings	$E \frac{1}{8} S = S 88 E$		

Exn. 9 D.

Port of Sunderland.

Rotation No.

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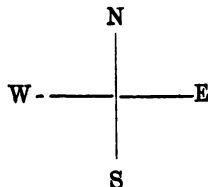
EXAMINATION IN CHART.

ADDITIONAL FOR MASTERS.

(4.) Find the course to steer by compass from Dungeness to Cape Alprech, (see question 1) to counteract the effect of a current which set SW $\frac{3}{4}$ W true, or WSW magnetic, at the rate of 3 miles per hour, the ship making by log 9 miles per hour; also the distance the ship would then make good per hour towards Cape Alprech?

SOLUTION OF THE PRECEDING QUESTION.

- (4.) Draw the figure as in the preceding examples, then
By *The True Chart*, to *Points, Degrees and Minutes*.



True course from B to C, E by S = S 78° 45' E

Variation from chart 18 25 W to right

Mag. course SE by E $\frac{3}{4}$ E = S 60 20 E

Deviation to left 15 53 E

Compass course E by S $\frac{1}{4}$ S = S 76 18 E

To Find the Deviation.

Course.	Dev.	
SE by E	14	14 0
ESE	19	+1 58
	<u>5</u>	<u>15 58</u>
	60	
	<u>8)300</u>	
	37.5	
	8	
	<u>6,0)11,2.5</u>	
	1 52.5	

By the Magnetic Chart, to Points and Degrees.

Magnetic course	SE by E $\frac{1}{2}$ E = S 60° East
Deviation	16 E to left
Compass course	E by S $\frac{1}{4}$ S = S 76 E

Distance AC = $7\frac{1}{2}$ miles made good per hour from Dungeness towards Cape Alprech.

EXERCISES.

FOR ALL GRADES WHERE THE CHART IS USED.

(1.) Using deviation card No..... Find the course to steer by compass from the South Foreland High Light House to Calais Pier End; also the distance?

Answer.—Compass Course S 49° 38' E, or SE $\frac{1}{2}$ E.
 Distance 20 $\frac{1}{2}$ miles
 Variation 18° 20 W
 Deviation 7 30 E

(2.) With the ship's head on the above named compass course, Dover Castle, bore, W by N $\frac{1}{4}$ N, the South Sand Head Light Ship bore NE $\frac{1}{4}$ N by the same compass; find the ship's position?

Answer.—Latitude 51° 6 $\frac{1}{2}$ ' N
 Longitude 1 26" E

(3.) With the ship's head as above the South Sand Head Light Ship bore by compass E by N $\frac{1}{4}$ N and after continuing the same course $5\frac{1}{2}$ miles, it bore N by W $\frac{1}{4}$ W; find the position of the ship, and her distance from the Light Ship at the time of taking the second bearing?

Answer.—Latitude 51° 4 $\frac{1}{2}$ ' N
 Longitude 1 31 $\frac{1}{2}$ E
 Distance 4 $\frac{1}{2}$ miles.

ADDITIONAL FOR MASTERS.

(4.) Find the course to steer by compass from the South Foreland to Calais (see question 1,) to counteract the effect of a current, or tide, which set SW $\frac{1}{4}$ S true, SW by W magnetic, at the rate of $2\frac{1}{4}$ miles per hour, the ship making by log 11 miles per hour; also the distance the ship would then make good per hour towards Calais?

Answer.—Compass Course S 70° 12' E, or E by S $\frac{1}{4}$ S
 Distance 10 $\frac{1}{2}$ miles per hour

II.—EXERCISES IN EXAMINATION IN CHART.

FOR ALL GRADES WHERE THE CHART IS USED.

(1.) Using deviation card No..... find the course to steer by compass from the South Foreland to Dungeness; also the distance?

Answer.—Compass Course S $84^{\circ} 38'$ W; or W $\frac{1}{4}$ S
 Distance 20 $\frac{1}{2}$ miles
 Variation $18^{\circ} 25'$ W
 Deviation 17 0 W

(2.) With the ship's head on the above named compass course the South Foreland High Light House bore by compass E by N $\frac{1}{4}$ N, and the Varne Light Ship bore S by W $\frac{1}{4}$ W by the same compass; find the ship's position?

Answer.—Latitude $51^{\circ} 14'$ N
 Longitude 1 $18\frac{1}{2}$ E

(8.) With the ship's head as above, the Varne bore by compass S $\frac{1}{4}$ W, and after continuing on the same course $7\frac{1}{2}$ miles, it bore SE $\frac{1}{4}$ E; find the position of the ship, and her distance from the Varne at the time of taking the second bearing?

Answer.—Latitude $50^{\circ} 56\frac{1}{2}'$ N
 Longitude 1 $2\frac{1}{2}$ E
 Distance $9\frac{1}{2}$ miles

ADDITIONAL FOR MASTERS.

(4.) Find the course to steer by compass from the South Foreland to Dungeness (see question 1.) to counteract the effect of a current which set SW by W $\frac{1}{4}$ W magnetic or SW $\frac{3}{4}$ W true, at the rate of 8 miles per hour, the ship making by log 8 miles per hour; also the distance the ship would then make good per hour towards Dungeness?

Answer.—Compass Course S $88^{\circ} 57'$; or W $\frac{1}{4}$ S
 Distance 11 miles

III.

FOR ALL GRADES WHERE THE CHART IS USED.

(1.) Using deviation card No..... find the course to steer by compass from Cape Alprech to Dungeness; also the distance?

Answer.—Compass Course N $27^{\circ} 8'$ W, or NNW $\frac{1}{4}$ W
 Distance 26 miles
 Variation $18^{\circ} 25'$ W
 Deviation 15 0 W

(2.) With the ship's head on the above named compass course Cape Grisnez bore E by N, and the Varne Light Ship bore by the same compass N $\frac{1}{4}$ E; find the ship's position?

Answer.—Latitude $50 48'$ N
 Longitude 1 25 E

(8.) With the ship's head as above, Cape Grisnez bore by compass NE $\frac{3}{4}$ E, and after continuing on the same course 12 miles, it bore ESE ; find the position of the ship, and her distance from the Cape at the time of taking the second bearing ?

Answer.—Latitude $50^{\circ} 49\frac{1}{4}'$ N
Longitude $1^{\circ} 14'$ E
Distance $18\frac{1}{4}$ miles

ADDITIONAL FOR MASTERS.

(4.) Find the course to steer by compass from Cape Alprech to Dungeness (see question 1,) to counteract the effect of a current which set N by E $\frac{3}{4}$ E true, or NE by N magnetic, at the rate of 8 miles per hour, the ship making by log $8\frac{1}{4}$ miles per hour ; also the distance the ship would then make good per hour towards Cape Alprech ?

Answer.—Compass Course N $42^{\circ} 44'$ W, NW $\frac{1}{4}$ W
Distance $8\frac{1}{4}$ miles

IV.

FOR ALL GRADES WHERE THE CHART IS USED.

(1.) Using deviation card No..... find the course to steer by compass from Calais Pier End towards the South Foreland High Light ; also the distance ?

Answer.—Compass Course N $27^{\circ} 8'$ W, or NNW $\frac{3}{4}$ W.
Distance $20\frac{1}{4}$ miles
Variation $18^{\circ} 20'$ W
Deviation $15^{\circ} 0'$ W

(2.) With the ship's head on the above named Compass Course Gravelines Light House bore by Compass SE $\frac{1}{4}$ E, and Cape Grisnez Light House bore SW by W $\frac{1}{8}$ W by the same Compass ; find the ship's position ?

Answer.—Latitude $51^{\circ} 0\frac{3}{4}'$ N
Longitude $1^{\circ} 48\frac{1}{4}'$ E

(3.) With the ship's head as above, Cape Grisnez bore W $\frac{1}{4}$ S and after continuing the same course 9 miles it bore SW $\frac{3}{4}$ S ; find the position of the ship, and her distance from the Cape at the time of taking the second bearing ?

Answer.—Latitude $51^{\circ} 4'$ N
Longitude $1^{\circ} 86'$ E
Distance $11\frac{1}{4}$ miles.

ADDITIONAL FOR MASTERS.

(4.) Find the course to steer by compass from Calais to the South Foreland (see question 1) to counteract the effect of a current, or tide, which set E by N $\frac{3}{4}$ N true, or East magnetic, at the rate of 8 miles per hour, the ship making by log 10 miles per hour ; also the distance the ship would then make good per hour towards the Foreland ?

Answer.—Compass Course N $37^{\circ} 8'$ W or NW $\frac{3}{4}$ N
Distance $7\frac{1}{4}$ miles.

V. EXAMINATION IN CHART.

FOR ALL GRADES WHERE THE CHART IS USED.

(1.) Using deviation card No..... find the course to steer by compass from Dungeness to the South Foreland; also the distance.

Answer.—Compass Course N $17^{\circ} 27'$ E, or N by E $\frac{1}{2}$ E
 Distance $20\frac{1}{2}$ miles
 Variation 16° 0'E Assumed.
 Deviation 14 22 E

(2.) With the ship's head on the above named Compass course, South Foreland bore by compass NE $\frac{1}{4}$ E and the Varne Light Ship bore SE by the same Compass; find the ship's position?

Answer.—Latitude $51^{\circ} 0\frac{1}{2}'$ N
 Longitude 1 9 E

(3.) With the ship's head as above the Varne bore by compass NE by E $\frac{3}{4}$ E, and after continuing on the same course 12 miles, it bore SE $\frac{1}{4}$ E, find the position of the ship, and her distance from the Varne at the time of taking the second bearing?

Answer.—Latitude $51^{\circ} 8'$ N
 Longitude 1' $18\frac{1}{2}'$ E
 Distance $7\frac{1}{2}$ miles

ADDITIONAL FOR MASTERS.

(4.) Find the course to steer by compass from Dungeness to the South Foreland (see question 1) to counteract the effect of a current which set SE $\frac{1}{4}$ E true, or SSW $\frac{1}{4}$ W magnetic, at the rate of $2\frac{1}{2}$ miles per hour, the ship making by log 10 miles per hour towards the Foreland?

Answer.—Compass Course N $17^{\circ} 27'$ E, or N by E $\frac{1}{2}$ E
 Distance $7\frac{1}{2}$ miles

VI.

FOR ALL GRADES WHERE THE CHART IS USED.

(1.) Using deviation card No.....find the course to steer from the Needles to Cape La Heve; also the distance?

Answer.—Compass Course S $19^{\circ} 1'E$, or S by E $\frac{1}{4}$ E
 Distance 94 miles
 Variation $20^{\circ} 10' W$
 Deviation 8 0 W

(2.) With the ship's head on the above named compass course the Needles bore N by W $\frac{1}{4}$ W and St. Catherine's bore E $\frac{1}{4}$ S by the same compass; find the ship's position?

Answer.—Latitude $50^{\circ} 38' N$
Longitude $1^{\circ} 25' W$

(8.) With the ship's head as above St. Catherine's Light bore SE by E $\frac{1}{4}$ E, and after continuing the same course 16 miles it bore N $\frac{1}{4}$ E; find the position of the ship and her distance from St. Catherine's at the time of taking the second bearing?

Answer.—Latitude $50^{\circ} 23' N$
Longitude $1^{\circ} 10\frac{1}{2}' W$
Distance $12\frac{1}{4}$ miles

ADDITIONAL FOR MASTERS.

(4.) Find the course to steer by compass from the Needles to Cape La Heve to counteract the effect of a current, or tide, which set E $\frac{1}{4}$ N true, or E by S magnetic, at the rate of 2 miles per hour, the ship making by log 8 miles per hour; also the distance the ship would then make good per hour towards the Cape?

Answer.—Compass Course S $6^{\circ} 46' E$, S $\frac{1}{4}$ E
Distance 9 miles per hour.

VII.

FOR ALL GRADES WHERE THE CHART IS USED.

(1.) Using deviation card No..... find the course to steer by compass from Cape La Heve to the Needles; also the distance?

Answer.—Compass Course N $14^{\circ} 1' W$; or N by W $\frac{1}{4}$ W
Distance 94 miles
Variation $20^{\circ} 10' W$
Deviation $8^{\circ} 0' W$

(2.) With the ship's head on the above named compass course Fecamp Light House, bore by compass SE by E $\frac{1}{4}$ E, and Cape La Heve Light House bore S by E $\frac{1}{4}$ E by the same compass; find the ship's position?

Answer.—Latitude $49^{\circ} 47' N$
Longitude $0^{\circ} 19\frac{1}{4}' W$

(8.) With the ship's head as above Cape d'Antifer by compass, bore E by N $\frac{1}{4}$ N, and after continuing on the same course, 25 miles, it bore SE $\frac{1}{4}$ S; find the position of the ship, and her distance from the Cape at the time of taking the second bearing?

Answer.—Latitude $49^{\circ} 52\frac{1}{4}' N$
Longitude $0^{\circ} 29' W$
Distance 27 miles

ADDITIONAL FOR MASTERS.

(4.) Find the course to steer by compass from Cape La Heve to the Needles (see question 1,) to counteract the effect of a current, or tide, which set $W \frac{1}{2} S$ true, or W by N magnetic, at the rate of 2 miles per hour, the ship making by log 7 miles per hour; also the distance the ship would then make good per hour towards the Needles?

Answer.—Compass Course $N 5^{\circ} 28' W$; or $N 2\frac{1}{4} W$
 Distance 8 miles, nearly

VIII.

FOR ALL GRADES WHERE THE CHART IS USED.

(1.) Using deviation card No..... find the course to steer by compass from Cape La Heve to Cape Barfleur; also the distance?

Answer.—Compass Course $N 38^{\circ} 56' W$; or $NW \frac{1}{4} N$
 Distance 52 miles
 Variation $20^{\circ} 10' W$
 Deviation $18 15 W$

(2.) With the ship's head on the above named compass course Cape Barfleur bore by compass $SSE \frac{3}{4} E$, and Cape La Hague, bore by the same compass $W \frac{3}{4} S$; find the ship's position?

Answer.—Latitude $49^{\circ} 50' N$
 Longitude $1 46 W$

(3.) With the ship's head as above, Cape Barfleur bore by compass $NW \frac{3}{4} W$, and after continuing on the same course, 17 miles, it bore $S \frac{3}{4} E$; find the position of the ship, and her distance from Cape Barfleur at the time of her taking the second bearing?

Answer.—Latitude $49^{\circ} 45' N$
 Longitude $1 20 W$
 Distance $4\frac{1}{2}$ miles

ADDITIONAL FOR MASTERS.

(4.) Find the course to steer by compass from Cape La Heve to Cape Barfleur to counteract the effect of a current which set W by $N \frac{1}{4} N$ true, or NW by $W \frac{1}{4} W$ magnetic, at the rate of three miles per hour, and the ship was making by log 10 miles per hour; also the distance the ship would then make good per hour towards Cape Barfleur?

Answer.—Compass Course $N 38^{\circ} 56' W$; or $NW \frac{1}{4} N$
 Distance 18 miles per hour.

Note.—In this example the current set in the same direction as the ship sailed; hence the sum of the rate of the current and the rate of the ship is the distance made good per hour.

Port of _____

Rotation No.

EXAMINATION PAPER II.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A

SECOND MATE.

This paper to be used at the above port this _____ day of _____

for Minor
rections.

1.—Multiply 50000 by 6000 by common logarithms

50000 log.....4·698970

6000 log.....8·778151

800 000 000 log.....8·477121

In this question, the decimal part of the log of the first four figures, namely 5000, is 698970, which is also the decimal part of the logs of the numbers, 5, 50, 500, 5000, 50 000, and so on; but by Bergen's Navigation, page 18, Article 18; the index of 50 000 is 4.

In like manner, 477121 is the decimal part of the log of 8, and also of all the numbers formed by affixing ciphers to 8; and as the index of the product is 8, ciphers must be affixed to 8000 so as to make up 9 integers.

2.—Divide 6·394 by 2·43 by common logarithms.

6·394 log.....0·805778

2·43 log.....0·385606

2·681 log.....0·420167

Here, by Bergen's Navigation, Article 18, the indices are all 0, and therefore there must be one integer to the left of the decimal point.

The Candidate should sign his name in full at the foot of every page.

PAPER II. EXAMINATION FOR SECOND MATES.

Space for minor corrections.	
N	
W-----E	
S	
N. 68° W.	
V 25° W. }	
D 9 W. }	34 W.
N. 102 W.	
	180
S. 78 W.	
N. 68° W.	
L	11
N. 79 W.	
V 25° W. }	7 W.
D 18 E. }	
N. 86 W.	
N. 79° W.	
L	8
N. 87 W.	
V 25 W. }	6 W.
D 19 E. }	
N. 93 W.	
	180
S. 87 W.	
L	8
S. 90° W.	
	8
S. 82 W.	
V 25° W. }	3 W.
D 22 E. }	
S. 79 W.	
N. 39 E.	
L	8
N. 47 E.	
V 25 W. }	34 W.
D 9 W. }	
N. 13 E.	
N. 68° E.	
L	14
N. 82 E.	
V 25 W. }	36 W.
D 11 W. }	
N. 46 E.	
N. 73 W.	
L	6
N. 79 W.	
V 25° W. }	7 W.
D 18 E. }	
N. 86 W.	
N. 68° W.	
V	25 W.
N. 93 W.	
	180
S. 87 W.	

Hrs.	Courses.	Knts.	10ths	Winds.	Lee-way.	Dev.	Remarks.
1	N 68° W	4	3	N.	11°	18° E	A point St. in Lat. 65° 29' N. Long. 178° 45' W. bearing by Compass S 68° E
2		4	4				
3		4	5				
4		5	8				
5	N 79° W	5	8	N. by W.	8°	19° E	(Ship's Head N39° E Deviation as per log) Dist. 20 miles.
6		6	1				
7		6	2				
8		6	9				
9	W	6	9	N.N.W.	8°	22° E	Variation 25° W
10		6	8				
11		6	2				
12		6	1				
1	N 39° E	5	7	NNW ½ W	8°	9° W	A current set Correct Magnetic N 68° W
2		5	3				
3		5	5				
4		5	5				
5	N 68° E	4	7	N.	14°	11° W	13 miles from the time the departure was taken to the end of the day.
6		4	6				
7		4	5				
8		4	2				
9	N 73° W	4	3	N. ½ W.	6°	18° E	
10		4	7				
11		4	8				
12		5	2				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

Corrected Courses.	Dist.	N.	S.	E.	W.
S 78° W	20		4.2		19.6
N 86 W	19	1.3			19.0
S 87 W	25		1.3		25.0
S 79 W	26		5.0		25.5
N 13 E	22	21.4		4.9	
N 46 E	18	12.5		12.9	
N 86 W	19	1.3			19.0
S 87 W	13		0.7		13.0
		36.5	11.2	17.8	121.1
		11.2			17.8
		25.3			103.3

Lat. left 65° 29' N
Diff. lat 25 N

Long. left 178° 45' W
Diff. long. 4 12 W

Lat. in 65 54 N

Long. in 182 57 W

2) 131 23

360 0 W

Mid. lat. 65 41

or long in 177 3 E

TO FIND THE DIFF. LONGITUDE BY INSPECTION.

Mid lat. 65° Dep. 108·1	in lat. col. give 244	in dist col.
„ 66 Dep. 108·8	„ „ 254	„
Here the lat. is high and the mid lat. is near 65½ in this case proceed as annexed.	4)10	} Subtract.
	2·5	
	6,0)25,1·5	
Diff. long.	4,11·5	

TO FIND THE COURSE AND DIST. BY INSPECTION.

Enter Table II. with dep. 108·8 and diff. lat. 25·8; the nearest numbers to them are dep. 108·8 and lat. 25·9, which give the course 76° and dist. 1 07.

Hence we have course N 76° W, distance 107 miles.

In this question it would be more correct and less trouble to find the diff. lon. as follows.

Mid. lat. 65° 41'	sec.	0·885835
Dep. 108·8	log	2·014100
6,0)25,0·9	log	2·899485
Diff. long. 4 10·9		

By logs Course N 76° 24' W, distance 106·8 miles.

PAPER II.

EXAMINATION FOR SECOND MATES.

Space for Minor
Corrections.

- 4.—1877, March 20th, in longitude 172° W, the observed meridian altitude of the Sun's Lower Limb was $47^{\circ} 18'$ bearing South, index error 0, height of eye 22 feet.

Required the Latitude.

Var.	d. h. m. s.				Long. $172^{\circ} 0' W$			
	A.T.S. Mar.	20	0	0	0	Long. W	+	11 28 0
59 ²⁴ 11 ⁵								
29620 65164								
6,0)68,1-260								
11 21.2								
	0	0	20	N	Obs. alt.	47	18	0 S
	+11	21			Dip.		4	87
						47	18	28
	0	11	41	N	Corr.	—	0	48
						47	12	85
					Sem.	+	16	5
					True alt.	47	28	40
						90	0	0
					Z. D.	42	31	20 N
					Dec.	0	11	41 N
					Latitude	42	48	1 North

- 5.—In latitude $42^{\circ} 18'$ the departure made good was 54 miles

Required the difference of Longitude by parallel sailing.

Lat.	42 18	Sec.	0.180985
Dep.	54	log.	1.782894
Diff. long.	78.01	log.	1.868879

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PAPER II.

EXAMINATION FOR SECOND MATES—Continued.

ce for Minor
Corrections.

6.—Required the Course and Distance from A to B by calculation on Mercator's Principle.

Lat. of A $58^{\circ} 0' N$ Long. $0^{\circ} 39' E$
 Lat. of B $54^{\circ} 11' N$ Long. $7^{\circ} 58' E$

A Lat. $58^{\circ} 10' N$	m. pts. 4294	Long. $0^{\circ} 39' E$
B Lat. $54^{\circ} 11' N$	m. pts. 8888	Long. $7^{\circ} 58' E$
<u>8 49</u>	m.d.l. <u>411</u>	<u>7 14</u>
60		60

Diff. lat. 229 S

Diff. ong. 484 E

Diff. long. 484 log. +10 12.687490
 M.d.l. 411 log. 2.618842

Course $46^{\circ} 34' \tan.$ 10.028648

Course $46^{\circ} 34'$ sec. 0.162721
 D. lat. 229 log. 2.359885

Dist. 888.1 log. 2.522556

Course S $46^{\circ} 34' E$. Distance 888.1 miles.

Exn. 5.

Port of _____

Rotation No.

EXAMINATION PAPER II.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A
SECOND MATE.

To be used at the above Port this _____ day of _____ 18____

N.B.—A Candidate for Second Mate's Certificate of Competency will be required to work the Questions in Paper Exn. 4, in addition to the Questions in this Paper.

Space for minor
Corrections.

1.—1880. June 2nd. Find the time of High Water at Bordeaux, A.M. and P.M.

	d.	h.	m.		d.	h.	m.
Stan. Brest, June	2	11	32	A.M.	1	10	59
Const. Bordeaux	+	3	3		+	3	3
H.W. Bordeaux	2	2	35	P.M.	2	2	2
							A.M.

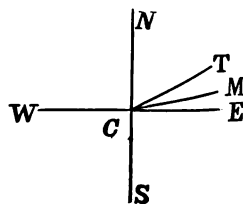
2.—1877. April 14th. At 6h. 42m. A.M., Appt. T. Ship, in latitude $47^{\circ} 9'$, longitude $89^{\circ} 16' E$. The Sun's Magnetic Amplitude was E by N.

Required the True Amplitude, and Error of the Compass; and supposing the Variation to be $25^{\circ} 10' W$, required the Deviation of the Compass for that position of the Ship's Head.

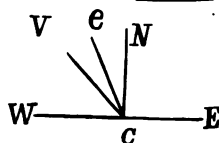
	d.	h.	m.	s.		Long.....
A.T.S., April ..	14	6	42	0	A.M.	$89^{\circ} 16' E$
	—	1	12			4
A.T.S., April ..	13	18	42	0		6,035,7 4
Longitude E ..	—	5	57	4		5 57 4
A.T.G., April..	13	12	44	56		
	14	0	0	0		
		11	15	4		
		11	3			

T left of M
error W

See page 113
Bergen's
Navigation.



Var.	Dec.		Lat.....	Dec.....	sec.....
55° 84	9 88 6 N		47 9	9 23	0-167439
11·8	— 10 8				sin..... 9-212291
16152	9 22 58 N	True amp. E	13 52 N		sin..... 9-379730
59224		Mag amp. E	11 15 N		
6,060,8-392		Err.	2 37 W		
10 8·8		Var.	25 10 W		
		Deviation ..	22 33 E		



to right of V.

Deviation E. See page 113 Bergen's Navigation.

The Candidate should sign his name in full at the foot of every page.

PAPER II.

EXAMINATION FOR SECOND MATES—Continued.

Space for Minor Corrections.

To find the daily rate.

d.	s.
Dec. 8	2 SL.
Dec. 18	20 Fast

10	22
2.2	

Gaining daily.

Var.

59 ^m 24
9.5

29620

53316

6,0)56,2-780

9 22.7

Cos.

76 18 0	9.874452
	458

76 18 53	9.873994
----------	----------

Diff.	864
	58

2592

4820

457,92

Sin.

45 10 0	9.850745
	+ 86

45 10 17	9.850781
----------	----------

Diff.	209
	17

1463

209

85.53

3.—1877. March 19th, P.M., at Ship in latitude $31^{\circ} 20' N$. The observed altitude of the Sun's L.L. was $80^{\circ} 57' 40''$, height of the eye 14 feet. Time by a Chronometer, March 19d. 14h. 32m. 17s., which was 2s. slow for mean noon at Greenwich, on December 8th, 1876, and on December 18th, 1876 was 20s. fast.

Required the longitude of Chronometer.

T Chron., Mar...	d.	h.	m.	s.	Dec...	d.	15 hours
fast	—	14	32	17	Dec...	31	04
				20		18	

gained

M.T.G., Mar. ..	19	14	28	35	Dec...	18	91.6.0
	20	0	0	0	Jan...	31	2.2

Time from nearest noon.....	9	81	25
	9	5	

Dec.

0 0 0	18 N
0 9 28	S

0 9 10	S
90 0 0	

P.D. 90 9 10

Eq. T.

m. s.	7 32.80
+	7.14

+	7 39.94
---	---------

Var.

0.752
9.5

3760
6768

7.1440

Obs. alt... 80 57 40

Dip. — 3 41

80 58 59

Corr. — 1 28

80 52 31

Sem. + 16 5

True alt... 81 8 36

Alt. 81 8 36

Lat. 81 20 0

P.D..... 90 9 10

152 37 46

Half sum .. 76 18 53

Diff. 45 10 17

log. 9.298238

0

8 = 1

H.A..... 3 30 29

Eq. T. + 7 40

M.T.S., Mar... 19 8 38 9

M.T.G., Mar... 19 14 28 35

10 50 36

60 120

4)650 146

120

Longitude.. 162 36 80 West

Exn. 6.

Notation No.

Port of _____

EXAMINATION PAPER II.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS AN
ONLY MATE.

To be used at the above port this _____ day of _____ 18

N.B.—A Candidate for an Only Mate's Certificate of Competency will be required to work the Questions in Papers Exn. 4 and Exn. 5, in addition to the Questions in this paper.

Space for Minor
Corrections.

1.—1877, June 18th, mean time at Ship 8h 45m P.M. in latitude $42^{\circ} 2' S$, longitude $27^{\circ} 23' W$. The Sun's bearing by Compass NW $\frac{1}{2}$ W, altitude L.L. $6^{\circ} 28'$. Height of the eye 18 feet. Required the True Azimuth, and Error of the Compass; and supposing the Variation to be $5^{\circ} 20' W$, required the Deviation of the Compass for that position of the Ship's head; both from the Altitude and by the Time Azimuth Tables.

	d.	h.	m.	s.	
M.T.S. June....	18	8	45	0	P.M.
Longitude W ..	+	1	49	32	

Long. $27^{\circ} 23' W$
4

M.T.G. June.... 18 5 34 32

6,0)10,9 32

5-6

1 49 32

Var.

$23^{\circ} 14' 45'' N$
+ 45

Obs. alt.... $6^{\circ} 28' 0''$
Dep. 4 11

$8^{\circ} 09'$
5-6
 $23^{\circ} 15' 30'' N$
90 0 0

6 23 49
Cor. 7 47

4854
4045

P.D. 118 15 30

6 16 2
Sem..... + 15 47

45-304

True alt.... 6 31 49

BY SUN'S ALTITUDE.

Figure for error.

Alt.....	$6^{\circ} 31' 49''$	sec	0-002630
Lat.	$42^{\circ} 2' 0''$	sec	0-129154
P.D.	118 15 30		

2)161 49 19

Half Sun	80 54 39	cos	9-196802
Diff.....	32 20 51	cos	9-926751

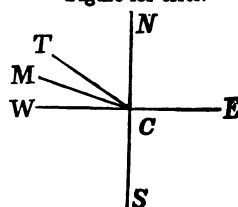
2)19-257037

Half as...	25 9 31	sin	9-628518
	2		878

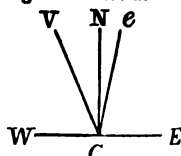
True az. N	50 19 2 W	448)14000(31
Mag. az. N	53 26 W	1344

Err.....	8 7 E	560
Var.....	5 20 W	448

Deviation 8 27 East.



T to right of M
Error E
Figure for deviation



e right of V
Deviation East.

The Candidate should sign his name in full at the foot of every page.

PAPER II.

EXAMINATION FOR ONLY MATES—Continued.

se for Minor
corrections.

BY AZIMUTH TABLES.

h. m. s.
M.T.S. 3 45 0 P.M.
Eq. T. + 10

A.T.S. 3 45 10 P.M.

A.T.S. 8h. 44m. lat. 42° S and dec. 23° N.
Give True Az. S 129° 46' W
180 0

or True Az. N 50 14 W
Mag. Az. N 53 26 W

Err. 8 12 E
Var. 5 20 W

Deviation 8 32 East.

2.—1877, April 14th, P.M. at Ship, in lat. by account 37° 33' S, long. 178° 16' E. The observed altitude of the Sun's L.L. North of the observer was 42° 12', height of eye 22 feet. Time by watch, April 15d. 0h. 22m. 4s., which had been found to be 45m. 12s. fast of apparent time at ship.

The difference of Longitude made to the West was 32.5 after the error on Apparent Time at Ship was determined.

Required the latitude by the Reduction to the Meridian.

d. h. m. s.		
T.W., April .. 15 0 22 4	D.L. .. 32.5	Long. .. 178 16 E
fast — 45 12	4	4
14 23 36 52	6,0)13,0-0	6,0)71,8 4

D.L.W. — 2 10	2m. 10s.	11 53 4
--------------------	----------	---------

A.T.S., Apr... 14 23 34 42	h. m. s.
Long. E — 11 53 4	24 0 0
	23 34 42

A.T.G., Apr.. 14 11 41 38	T. from noon 25 18
11. 7	

Var.	9 33 6 N	Obs. alt... 42 12 0 N
58.84	+ 10 30	Dip. — 4 37
11.7	9 43 36 N	42 7 23
87688		Corr. — 0 58
59224		42 6 25
6,0)62,9-928		Sem. + 15 58
10 29-9		True alt.. 42 22 23

The Candidate should sign his name in full at the foot of every page.

Exn. 7.
(late E. F. 4.)

Port of _____

Station No.

EXAMINATION PAPER II.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A

MASTER ORDINARY.

To be used at the above Port this _____ day of _____ 18

N.B.—A Candidate for an Ordinary Master's Certificate of Competency will be required to work the Questions in Papers Exn. 4, Exn. 5, and Exn. 6, in addition to the Questions in this Paper.

Space for Minor
Corrections.

1.—1877, February 11th, the observed Meridian Altitude of the Star α Pegasi (Markab) bearing South, was $58^{\circ} 47' 10''$, I.E. $1' 40''$, height of the eye 22 feet.

Required the Latitude.

Obs. alt.....	58	47	10	S
I.E.....	+	1	40	
	58	48	50	
Dip.....	—	4	87	
	58	44	18	
Ref.	—	0	85	
	58	48	88	
True lat. ...	90	0	0	
	81	16	22	N
Z. D.....	14	82	86	N
	45	48	58	North

The Candidate should sign his name in full at the foot of every page.

ON SOUNDINGS.

To find the correction to be applied to the depth obtained by the lead line when the place is a Port of Reference.

EXAMPLE I.—1881, January 20th, at noon, off Sheerness, took a cast of the lead; required the correction to be applied to it.

	d.	h.	m.		ft.	in.
T.H.W. Sheerness, Jan.	20	8	88	P.M.	Height tide, Sheerness	15 4
M.T.S.	Jan.	20	0 0	noon	$\frac{1}{4}$ mean spring range	— 8 0
Time from H W.		8	88		above mean level	7 4
			ft. in.			
$\frac{1}{4}$ Mean spring range			8 0			
Correction from Table B.—			1 10			

Answer 6 2; to be subtracted from the depth shown by the lead, in order to find the depth marked on the chart.

Notes.—The time of high water and the height of the tide at Sheerness, on the 20th January, are found in the "Admiralty Tide Tables," page 8rd, and Table B is found in page 98.

Enter Table B with the difference between the time of high water, and the time of the cast and the difference between the height of the tide and $\frac{1}{4}$ mean spring range, and apply the result to the $\frac{1}{4}$ mean spring range according to the sign + or — given in the Table.

The quantity thus found must be subtracted from the depth given by the lead, to find the depth marked on the chart.

ON INTERPOLATION.

The quantities in Table B are only given for every foot, between 8 and 24, above the mean level of the sea, and for every 80 minutes between 0h. and 6h. If they be required for intermediate heights, or times; then proceed as follows:—

Between 7 and 8 feet.				Between 8 80 and 4 0			
ft.	h. m.	ft. in.		ft.	h. m.	ft. in.	
7 give	8 80	1 10		7 give	4 0	8 6	
8 "		2 1		8 "		4 0	
in.				in.			
4 | $\frac{1}{4}$ | )		8	add.	4 | $\frac{1}{4}$ | )		6	add.
		1				2	
ft. in.				ft. in.			
7 4 give		1 11		7 4 give		8 8	

Thus the correction corresponding to 8h. 80m. from H.W. and 7ft. 4in. above the mean level of the sea is 2ft. 4in., which differs from 1ft. 10in. by 6 inches.

There is a great deal of trouble in interpolating in Table B as above. The following Rule kindly given to the author by Capt. Wm. B. Duncan enables the student to find the correction very easily by using Table II.

Rule.—Find the half difference between 8 hours, and the time from high water. If there be no hours in this half difference, consider the minutes as degrees. If there be 1 hour in it add 60 to the minutes, and consider the sum as degrees. Enter Table II. with those degrees, and the height above the mean level in the “dist” column, and the corresponding “dep” is the correction given in Table B. To be added if the time from high water be less than 8 hours, but to be subtracted if the time be greater than 8 hours.

Taking the preceding example.

h. m.			ft. in.
8	0		7 4 Height above mean level.
8	88	Time from high water	= 7·8 when expressed in decimals

2)88 Diff.

19 Half Diff.

19° in Table II., considered as a course, and 7·8 considered as a distance, give 2·88 as a departure.

ft.
2·88
12
—
4·56
—

Thus the correction to the nearest inch is 2ft. 5in., which is nearly the same as is found by the preceding troublesome interpolation; and it is to be subtracted because the time from high water is greater than 8 hours.

Assuming that the rise and fall of the tide may be represented by a circle whose diameter is the mean spring range, Capt. Duncan's method is mathematically correct, but the following slight modification of it by the author is a very close approximation, and it does away with the necessity of reducing the quantities to decimals.

Rule.—Find the degrees in Table II. as before, and consider the height above the mean level, namely: 7 ft. 4 in. as the number 74 in a “dist.” column and the corresponding “dep.” 24·1.

Consider the decimal point to be shifted one place to the left, it thus becomes 2·41, which consider as 2 ft. 4 in. As the second decimal is below 5, reject it, if it were 5 or upwards then add 1 to the first decimal.

Thus the correction is the same as is found by interpolation.

Note.—The error of the correction as found by this method will never exceed 2 inches, as any person may convince himself by examining Table B. by it.

Example II.—1881, on September 16th, at 4 p.m., off Harwich, took a cast of the lead; required the correction to be subtracted.

	d.	h.	m.		ft.	in.
T.H.W. Harwich	16	5	41	P.M.	H.T. Harwich	9 5
M.T.S.	16	4	0	P.M.	$\frac{1}{2}$ M.S.R.	5 9
T. from H.W.		1	41		Above M.L.	8 8
$\frac{1}{2}$ M.S.R.				ft. in.		
				5 9		
Corr. Table B. +				2 10		
Answer				8 7	to be subtracted.	

BY TABLE II.

T. from H.W.	h. m.	
	1 41	less than 8 h +
	8 0	
	2)1 19	
	89° and 88 dist. give 28·9 dep.	

	ft. in.
$\frac{1}{2}$ M.S.R.	5 9
Corr.	+ 2 4
Answer	8 1 to be subtracted.

Example III.—1881, January 12th, at 6 A.M., off North Shields, took a cast; required the correction.

	d.	h.	m.		ft.	in.
T.H.W. Shields	12	1	17	A.M.	H.T.	10 2
M.T.S.	12	6	0	A.M.	$\frac{1}{2}$ M.S.R.	6 8
T. from H.W.		4	48		Above M.L.	8 6
$\frac{1}{2}$ M.S.R.				ft. in.		
				6 8		
Corr. Table B. —				2 10		
Answer				8 10	to be subtracted.	

BY TABLE II.

T. from H.W.	h. m.	
	4 48	more than 8 h. —
	8 0	
	2)1 48	
	51° and 86 dist. give 28·0 dep.	
$\frac{1}{2}$ M.S.R.	6 8	
Corr.	—2 8	
Answer	4 0	to be subtracted

Example IV.—1881, January 18th at 6 A.M., off Weston Super Mare, took a cast, required the correction ?

	d.	h.	m.		ft.	in.
T.H.W. Weston	18	8	31 A.M.	H.T.	85	9
M.T.S.	18	6	0 A.M.	$\frac{1}{2}$ M.S.R.	18	7
T. from H.W.	<u>2 81</u>				<u>17 2</u>	

	ft.	in.
$\frac{1}{2}$ M.S.R.	18	7
Corr. Table B	+ 4	5
Answer	<u>28 0 ; to be subtracted</u>	

BY TABLE II.

	h.	m.
T. from H.W.	2	31 less than 8h +
	8	0
	<u>2) 29</u>	
	14° and 172 dist. give 41.6 dep.	

	ft.	in.
$\frac{1}{2}$ M.S.R.	18	7
	+ 4	2
Answer	<u>22 9 to be subtracted</u>	

Example V.—1881, January, at midnight, between 11th and 12th, off North Shields, took a cast; required the correction ?

	d.	d.	m.		ft.	in.
T.H.W. Shields	12	1	17 A.M.	H.T.	10	2
M.T.S.	12	0	0 Midnight	$\frac{1}{2}$ M.S.R.	6	8
T. from H.W.	<u>1 17</u>			Above M.L.	8	6

	ft.	in.
$\frac{1}{2}$ M.S.R.	6	8
Corr. Table B	+ 2	10
Answer	<u>9 6 to be subtracted</u>	

BY TABLE II.

	ft. in.	
T. from H.W.	1 17 less than 3h. +	
	8 0	
	2)1 48	
	51° and 86 dist. give 28·0 dep.	
	ft. in.	
‡ M.S.R.	6 8	
Corr.	+ 2 8	
Answer	9 4 to be subtracted.	

Example VI.—1881, January 17th, at 4h. 30m. A.M., off North Shields, took a cast; required the correction?

	d. h. m.		ft. in.
T.H.W. Shields	17 4 30 P.M.	H.T.	12 5
M.T.S.	17 4 30 P.M.	‡ M.S.R.	6 8
T. from H.W.	0 0	Above M.L.	5 9
	ft. in.		
‡ M.S.R.	6 8		
Corr. Table B	+ 5 9		
Answer	12 5 to be subtracted		

BY TABLE II.

	h. m.	
T. from H.W.	0 0 less than 3h. +	
	8 0	
	2)8 0	
	1 30	
	60	
	90° and 59 dist, give 59·0 dep.	
	ft. in.	
‡ M.S.R.	6 8	
	+ 5 9	
	12 5 to be subtracted	

		ft. in.
$\frac{1}{2}$ M.S.R.		4 9
Corr. Table B.	+	2 10
Answer		7 7 to subtracted.

Note.—In the Tide Tables, page 157, the rise in Springs, at Dunmanus, is $9\frac{1}{2}$ feet; therefore the $\frac{1}{2}$ M S R = $(9\text{ft. } 6\text{in.}) \div 2 = 4\text{ft. } 9$.

BY TABLE II.

	h. m.	
T. from H.W.	1 24	less than 8h. +
	8 0	
	2)1 86	
	48°	and 89 as dist. give dep. 29·0.

		ft. in.
$\frac{1}{2}$ M.S.R.		4 9
Corr.	+	2 9
Answer		7 6 to be subtracted.

Example IX.—1881, August, 15th, at 2h. 27m., P.M., off Valentia Harbour, took a cast of the lead; required the correction to be applied to it.

		d. h. m.		ft. in.
Queenstown	T.H.W. Aug.	15 8 51 P.M.	H.T.	10 5
Valentia	Constant	— 1 19	—	0 8
Valentia	T.H.W. Aug.	15 7 82 P.M.	H.T.	9 9
	M.T.S. Aug.	15 2 27 P.M.	$\frac{1}{2}$ M.S.R.	5 6
	T. from H.W.	5 5	Above M.L.	4 8

		ft. in.
$\frac{1}{2}$ M.S.R.		5 6
Corr. Table B.	—	8 6
Answer		2 0 to be subtracted.

Note.—In page 158, the rise in Springs at Valentia Harbour, is 11ft, therefore, the $\frac{1}{2}$ M.S.R. = $(11\text{ft.}) \div 2 = 5\text{ft. } 6\text{in.}$

BY TABLE II.

	ft. in.	
T. from H.W.	5 5	greater than 8h. —
	8 0	
	2)2 5	
	1 2	
	60	
	62°	and 48 dist. give dep. 88·0.

		ft. in.
$\frac{1}{2}$ M.S.R.		5 6
Corr.	—	8 8
Answer		1 10 to be subtracted.

When the given place is not a Port of Reference, and both constants with respect to such a Port are not given; proceed as follows:—

Example X.—1881, June, 7th, at 5h. 10m. A.M., off Kyle Akin, took a cast of the lead; required the correction.

See pages 156 and 155.

Thurso,	Full and change	H.W.	h. m.	H.T.	ft. in.
Kyle Akin,	.....	.....	8 28		13 8
			6 16	.....	15 6
Constants		—	2 12	+	2 8

$$\frac{1}{2} \text{ M.S.R.} = (15\text{ft. } 6\text{in.}) \div 2 = 7\text{ft. } 9\text{in.}$$

Thurso,	T.H.W. June,	d. h. m.	A.M.	H.T.	ft. in.
Kyle Akin,	Constants	— 2 12		+	2 8
Kyle Akin,	T.H.W. June,	7 1 40	A.M.	H.T.	11 11
	M.T.S. June,	7 5 10	A.M.	$\frac{1}{2}$ M.S.R.	7 9
	T. from H.W.	8 80		Above M.L.	4 2

	ft. in.
$\frac{1}{2}$ M.S.R.	7 9
Corr. Table B —	1 0
Answer	6 9 to be subtracted.

BY TABLE II.

T. from H.W.	h. m.	
	8 80	greater than 8h. —
	8 0	
	2) 80	
	15°	and 42 dist. give dep. 10·9.

	ft. in.
$\frac{1}{2}$ M.S.R.	7 9
Corr.	— 1 1
Answer	6 8 to be subtracted.

Example XI.—1881, December 8th, at 6h. 40m. P.M., off Killybegs, took a cast of the lead; required the correction.

Sligo Bay, Full and Change	H.W.	h. m.	P.M.	H.T.	ft. in.
Killybegs	.....	5 18		.....	11 8
Constants for Killybegs	—	0 2			0 0

Killybegs $\frac{1}{2}$ M.S.R. = (11ft. 8in.) $\div$ 2 = 5ft. 7in.

Sligo Bay,	T.H.W. Dec,	d. h. m.	P.M.	H.T.	ft. in.
Killybegs,	Constants	8 6 54			10 2
		— 0 2			0 0
Killybegs,	T.H.W. Dec.,	8 6 52	P.M.	H.T.	10 2
	M.T.S. Dec.,	8 6 40	P.M.	$\frac{1}{2}$ M.S.R.	5 7
		— 0 12			
	T. from H.W.			Above M.L.	4 7

	ft. in.
$\frac{1}{2}$ M.S.R.	5 7
Corr. Table B. +	4 7
Answer	10 2 to be subtracted.

BY TABLE II.

T. from H.W.	h. m.	
	0 12	less than 8h. +
	8 0	
	—	
	2)2 48	
	—	
	1 24	
	60	
	—	
	84° and 47 dist. give dep. 46° 7.	

	ft. in.
$\frac{1}{2}$ M.S.R.	5 7
Corr. +	4 7
Answer	10 2 to be subtracted.

Example XII.—1881, February, 10th, at 8h. 40m. P.M., off Rochelle, took a cast of the lead; required the correction.

Brest	T.H.W. Full and Change	h. m.	H.T.	ft. in.
Rochelle	.....	8 47	.....	19 0
		3 81		17 0
Constants	—	0 16	—	2 0

$\frac{1}{2}$ M.S.R. = (17ft.) $\div$ 2 = 8ft. 6in.

ADDITIONS, ALTERATIONS AND CORRECTIONS SINCE THE "SEAMANSHIP" WAS PRINTED.

DEVIATION OF THE COMPASS.

The following questions must be answered fully, and rough diagrams drawn at the side of the answers to shew the position of the correcting magnets and chain boxes.

Question 19. Your steering compass having a large error, how would you proceed to correct that compass by compensating magnets and soft iron, in order to reduce the error within manageable limits?

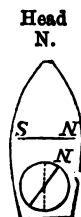
TO CORRECT THE SEMICIRCULAR DEVIATION.

Draw two chalk lines on the deck, at right angles to each other, one fore and aft, the other athwartships, and with their point of intersection under the centre of the compass needle.

BRING THE SHIP'S HEAD EITHER NORTH OR SOUTH, CORRECT MAGNETIC.

Place a magnet, or, if necessary, two, on the deck, athwartships, either before or abaft the binnacle, with its centre on the fore and aft line.

If the North end of the needle deviate towards the Starboard side, place the north end of the magnet towards the Starboard side.



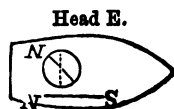
But if it deviate towards the port side, place the North end towards the Port side.

Then move the magnet gradually towards the binnacle, or from it, till the needle points correctly.

NEXT, BRING THE SHIPS HEAD EAST OR WEST, CORRECT MAGNETIC.

Place another magnet on the deck, fore and aft, at either side of the binnacle, with its centre on the athwartship line.

If the North end of the needle deviate towards the Bow, place the north end of the magnet towards the Bow.



But if it deviate towards the Stern, place the North end towards the Stern.

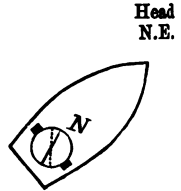
Then move the magnet towards the binnacle, or from it, till the needle points correctly.

TO CORRECT THE QUADRANTAL DEVIATION.

The binnacle being fitted with cast iron correctors, or with small brass boxes, one on each side, port and starboard, of the needle, and at the same height as it.

Then bring the Ship's head on one of the Quadrantal points, N.E., S.E., S.W., or N.W., correct magnetic.

Then move the correctors towards the needle or from it or put small chain in the boxes, till the needle points correctly



TO CORRECT THE HEELING ERROR.

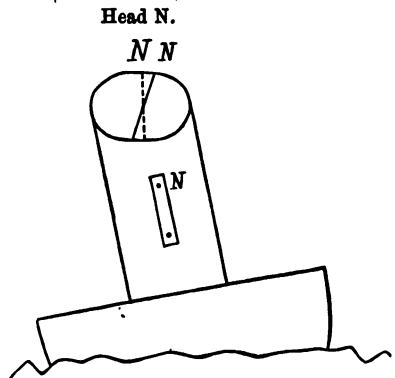
When the ship is upright, fix a vertical magnetic case exactly under the centre of the compass needle; bring the ship's head either North or South correct magnetic, and heel her over to either side.

If the North end of the needle deviate to the high side of the ship, place a magnet in the case with its North end upwards.

But if it deviate to the low side which will seldom happen, place the magnet with its north end downwards.

Then move the magnet up or down till the needle points correctly, and fix the magnet in this position.

Note. If the ship change her magnetic latitude considerably, repeat the preceding process.



ADDITIONS TO SUMNER'S METHOD.

The Examiners now require the Candidates to find the Sun's true bearing at the time of taking the first observation in Sumner's Method.

This is done as follows:—

When North of the Sun. Look to the Northward along the first line of bearing; then

When the first observation is taken in the forenoon, allow 90° to the right hand of the first line of bearing, the result is the Sun's true bearing.

When it is taken in the afternoon, allow 90° to the left hand.

When South of the Sun. Look to the Southward.

In the forenoon. Allow 90° to the left hand.

In the afternoon. Allow to the right hand.

Example. In page 162 of the fifth edition of the Seamanship, the first line of bearing is found to be true N. by E. $\frac{1}{4}$ E.

N. by E. $\frac{1}{4}$ E. in degrees is	N. 16	58 E.
Add	90	0
	N. 106	58 E.
	180	0
Sun's true bearing	S. 78	7 E.

NOTE. In Sumner's Method; the longitudes given by the Examiners are found with the same assumed latitudes, the second altitude, and the declination and equation of time due to the second Greenwich Date.

AN ACT TO PROVIDE FOR THE SAFE CARRIAGE OF GRAIN CARGOES BY MERCHANT SHIPPING.

Obligation to take precautions to prevent Grain Cargo from Shifting.

3. Where a grain cargo is laden on any British Ship all necessary and reasonable precautions (whether prescribed by this Act or not) shall be taken in order to prevent the grain cargo from shifting.

If such precautions have not been taken in the case of any such ship, the master of the ship, and any agent of the owner who was charged with the loading of the ship or the sending her to sea, shall each be liable to a penalty not exceeding three hundred pounds, and the owner of the ship shall also be liable to the same penalty, unless he shows that he took all reasonable means to enforce the observance of this section, and was not privy to the breach thereof.

Precautions against shifting of Grain Cargo laden in ports in Mediterranean or Black Sea, or on coast of North America.

4. Where a British ship laden with a grain cargo at any port in the Mediterranean or Black Sea is bound to ports outside the Straits of Gibraltar, or where a British Ship is laden with a grain cargo on the coast of North America, the following precautions to prevent the grain cargo from shifting shall be adopted, that is to say:

(a.) There shall not be carried between the decks, or, if the ship has more than two decks, between the main and upper decks, any grain in bulk, except such as may be necessary for feeding the cargo in the hold, and is carried in properly constructed feeders.

(b.) Where grain (except such as may be carried in properly constructed feeders) is carried in bulk in any hold or compartment and proper provision for filling up the same by feeders is not made, not less than one-fourth of the grain carried in the hold or compartment (as the case may be) shall be in bags supported on suitable platforms laid upon the grain in bulk: provided that this regulation with respect to bags shall not apply—

(i.) To oats, or cotton seed; nor

(ii.) To a ship which is a sailing ship of less than four hundred tons registered tonnage, and is not engaged in the Atlantic trade; nor

(iii.) To a ship laden at a port in the Mediterranean or Black Sea, if the ship is divided into compartments which are formed by substantial transverse partitions, and are fitted with longitudinal bulkheads, or such shifting boards as hereafter in this section mentioned, and if the ship does not carry more than one-fourth of the grain cargo, and not more than one thousand five hundred quarters, in any one compartment, bin, or division, and provided that each division of the lower hold is fitted with properly constructed feeders from the between decks; nor

(iv.) To a ship in which the grain cargo does not exceed one-half of the whole cargo of the ship, and the rest of the cargo consists of cotton, wool, flax, barrels, or sacks of flour, or other suitable cargo so stowed as to prevent the grain in any compartment, bin, or division from shifting.

(c.) Where grain is carried in the hold or between the decks, whether in bags or bulk, the hold or the space between the decks shall be divided by a longitudinal bulkhead, or by sufficient shifting boards which extend from deck to deck, or from the deck to the keelson, and are properly secured, and if the grain is in bulk are fitted grain-tight with proper fillings between the beams.

(d.) In loading, the grain shall be properly stowed, trimmed and secured.

In the event of the contravention of this section in the case of any ship, reasonable precautions to prevent the grain cargo of that ship from shifting shall be deemed not to have been taken, and the owner and master of the ship and any agent charged with loading her or sending her to sea shall be liable accordingly to a penalty under this Act.

Provided that nothing in this section shall exempt a person from any liability, civil or criminal, to which he would otherwise be subject for failing to adopt any reasonable precautions which, although not mentioned in this section, are reasonably required to prevent grain cargo from shifting.

Exemptions from precautions specified in this Act for ships laden in Mediterranean or Black Sea, or on coast of North America.

5. The precautions required by this Act to be adopted by ships laden with a grain cargo at a port in the Mediterranean or Black Sea, or on the coast of North America, shall not apply to ships loaded in accordance with regulations for the time being approved by the Board of Trade; nor to any ship constructed and loaded in accordance with any plan approved by the Board of Trade.

Notice by Master of kind and quantity of grain cargo.

6. Before a British ship laden with grain cargo at any port in the Mediterranean or Black Sea, bound to ports outside the Straits of Gibraltar, or laden with grain cargo on the coast of North America, leaves her final port of loading, or within forty-eight hours after leaving such port, the master shall deliver, or cause to be delivered, to the British Consular Officer, or, if it is in Her Majesty's dominions, to the principal officer of Customs at that port, a notice stating—

34 & 35 Vict. c. 110. 36 & 37 Vict. c. 85.

(1.) The draught of water and clear side, as defined by section five of the Merchant Shipping Act, 1871, and section four of the Merchant Shipping Act, 1873, of the said ship after the loading of her cargo has been completed at the said last port of loading ;

(2.) And also stating the following particulars in respect to the grain cargo, namely :—

(a.) The kind of grain and quantity thereof, which quantity may be stated in cubic feet, or in quarters, or bushels, or in tons weight ; and

(b.) The mode in which the grain cargo is stowed ; and

(c.) The precautions taken against shifting.

30 & 40 Vict. c. 36 ss. 50, 51.

The master shall also deliver a similar notice to the principal collector or other proper officer of Customs in the United Kingdom, together with the report required, to be made by the Customs Consolidation Act, 1876, on the arrival of the ship in the United Kingdom.

Every such notice shall be sent to the Board of Trade as soon as practicable by the officer receiving the same.

If the master fails to deliver any notice required by this section he shall be liable to a penalty not exceeding one hundred pounds: provided always, that the Board of Trade may, by notice published in the London Gazette, or in such other way as it may deem expedient, exempt ships laden at any particular port, or any class of such ships from the provisions of this section.

Penalty for false statement in notice,

7. Any master of a ship, who in any notice required by this Act wilfully makes any false statement or wilfully omits any material particular, shall be liable to a penalty not exceeding one hundred pounds.

Power of Board of Trade for enforcing of Act.

8. For the purpose of securing the observance of this Act, any officer having authority on that behalf from the Board of Trade, either general or special, shall have the same power as an inspector appointed under the Merchant Shipping Act, 1854, and shall also have power to inspect any grain cargo, and the mode in which the same is stowed.

Prosecution of offences and recovery of penalties.

9. Every offence punishable under this act, may be prosecuted summarily, and every penalty under this Act may be recovered and enforced summarily in like manner as offences and penalties under the Merchant Shipping Act, 1854, and the Acts amending the same.

Definitions.

10. For the purposes of this Act—

The expression "grain" means any corn, rice, paddy, pulse, seeds, nuts, or nut kernels.

The expression "ship laden with grain cargo" means a ship carrying a cargo of which the portion consisting of grain is more than one-third of the registered tonnage of the ship, and such third shall be computed, where the grain is reckoned in measures of capacity, at the rate of one hundred cubic feet for each ton of registered tonnage, and where the grain is reckoned in measures of weight, at the rate of two tons weight for each ton of registered tonnage.

Repeal of 39 & 40 Vict. c. 80 s. 22

11. Section twenty-two of the Merchant Shipping Act, 1876, is hereby repealed as from the commencement of this Act:

Provided that any offence against that section committed before the commencement of this Act may be prosecuted, and the penalty recovered and enforced in like manner as if the said section had continued to remain in force.

QUESTIONS ON GRAIN CARGOES.

Q. If a master do not take precautions to prevent grain cargo from shifting, what penalty is he liable to ?

A. Not exceeding £800.

Q. When a ship from the Mediterranean or Black Sea to ports outside of the Straits of Gibraltar, or from North America, is laden with grain ; what precautions should be taken against the grain shifting ?

A. There shall not be carried between decks, or between the main and upper Deck, any grain in bulk, except in feeders for feeding the cargo in the hold.

Q. What proportion of cargo in any compartment shall be in bags ?

A. Not less than one-fourth.

Q. How shall the bags be supported ?

A. On platforms laid on the grain in bulk.

Q. To what cargoes and ships do the regulations about bags not apply ?

A. To oats or cotton seed.

To sailing ships, less than 400 tons register, not in the Atlantic trade.

To ships from the Mediterranean or Black Sea, fitted with compartments, with fore and aft bulkheads, and feeders to each compartment ; not to contain more than one-fourth of the cargo, and not more than 1500 quarters in any compartment.

To a ship in which the grain does not exceed one-half of the whole cargo, and the rest consists of cotton, wool, flax, barrels or sacks of flour, so stowed as to prevent the cargo from shifting.

Q. When grain is carried in bags, or bulk, how should it be secured ?

A. By a fore and aft bulkhead, or shifting boards grain tight, from deck to deck, or from deck to keelson, with fittings between the beams.

Q. What further precautions will you take ?

A. Stow, trim, and secure the cargo properly.

Q. Shall the precautions apply to ships loaded in accordance with any plan approved by the Board of Trade ?

A. No.

Q. What notice shall the master give to the consul at the port of loading, and the collector of customs at the port of discharge ?

A. The draught of water and clear side. The kind and quantity of grain. How the grain is stowed, and what precautions are taken against it shifting.

Q. If the master fail to give such notice, or make any false statement, or omit any material particular, what penalty is he liable to ?

A. £100.

Exn. 9 a.

Rotation No.

Port of

ADJUSTMENTS OF THE SEXTANT.

The applicant will answer in writing, on a sheet of paper which will be given him by the examiner, all the following questions; numbering his answers with the numbers corresponding to the questions.

Question.

- 1 What is the first adjustment of the sextant ?
- 2 How do you make that adjustment ?
- 3 What is the second adjustment ?
- 4 Describe how you make that adjustment.
- 5 What is the third adjustment ?
- 6 How would you make the third adjustment ?
- 7 In the absence of a screw how would you proceed ?
- 8 How would you find the index error by the horizon ?
- 9 How is it to be applied ?
- 10 Place the index at error of minutes to be added, clamp it, and leave it.

(NOTE.—The examiner will see that it is correct.)

- 11 The examiner will then place the zero of the vernier on the arc, not near any of the marked divisions, and the candidate will read it.

NOTE.—In all cases the applicants will name or otherwise point out the screws used in the various adjustments.

The above completes the examination of second and only Mates.

In addition to the above, only Mates, first Mates, and Masters will be required to state in writing:—

- 12 How do you find the index error by the Sun ?
- 13 The readings being { 85.0 off } What is the index error, and how
 { 82.0 on } do you apply it ?
14. What proof have you that those measurements or angles have been taken with tolerable accuracy ?

*Elements from the Tide Tables for the
Examples, 1880.*

Example	Standard Port.	Date of Tide.		Given Port.	Constant.
I.	Brest	June	d. h. m. 2 11 32 A.M. 8 0 5 P.M.	Gibraltar	h. m. — 2 0
II.	Brest	June.....	1 10 59 P.M. 2 11 32 A.M.	Bordeaux	+ 3 3
III.	Brest	June.....	2 11 32 A.M. „ 8 0 5 A.M.	Bayonne	— 0 2
IV.	Holyhead...	April.....	2 2 50 A.M. „ 2 8 28 P.M.	Fishguard	— 3 15
V.	Queenstown	September	14 0 15 A.M. „ 14 0 59 P.M. „ 15 0 41 A.M.	Skull	— 0 59
VI.	Londonderry	December	8 0 59 P.M. „ 9 1 37 A.M. „ 8 0 22 A.M.	Coleraine	— 1 37

TIDE TABLES FOR JULY, 1880.

MONTH DAY.	MOON'S TRANSIT.	BREST (Entr. of Dockyard Basin.)						DEVONPORT (H.M. Dockyard.)						PORTSMOUTH. (H.M. Dockyard.)					
		Morning.			Afternoon.			Morning.			Afternoon.			Morning.			Afternoon.		
		Time	Height	Time	Height	Time	Height	Time	Height	Time	Height	Time	Height	Time	Height	Time	Height	Time	Height
	H. M.	H. M.	F. I.	H. M.	F. I.	H. M.	F. I.	H. M.	F. I.	H. M.	F. I.	H. M.	F. I.	H. M.	F. I.	H. M.	F. I.	H. M.	F. I.
1	7 11	10 38	13 10	11 12	13 8	—	—	0 4	12 1	5 57	10 9	6 28	10 8						
2	7 57	11 47	13 8	—	—	0 39	12 1	1 14	12 1	7 1	10 7	7 35	10 8						
3	8 43	0 22	13 10	0 54	14 1	1 48	12 2	2 22	12 4	8 10	10 9	8 44	10 11						
4	9 34	1 24	14 5	1 51	14 10	2 54	12 5	3 25	13 0	9 15	11 1	9 44	11 3						
5	10 23	2 15	15 3	2 36	15 8	3 55	12 11	4 20	13 8	10 9	11 6	10 31	11 9						
6	11 13	2 55	16 1	3 14	16 6	4 44	13 4	5 5	14 2	10 51	11 11	11 10	12 0						
7	0a 2	3 33	16 9	3 52	17 0	5 24	13 8	5 43	14 7	11 29	12 2	11 48	12 4						
8	0 46	4 10	17 2	4 28	17 3	6 2	13 11	6 20	15 0	—	—	0 7	12 5						
9	1 35	4 45	17 5	5 1	17 7	6 38	14 2	6 55	15 2	0 25	12 6	0 43	12 7						
10	2 19	5 17	17 8	5 34	17 9	7 10	14 2	7 25	15 0	1 1	12 7	1 18	12 8						

TIDAL CONSTANTS.

Ports of Great Britain.	Constants.		Standard Port for Reference.
	Time.	Height.	
	h. m.	ft. in.	
Selsea Bill	+ 0 4		Portsmouth
Bembridge Point	— 0 41		"
Christchurch	— 2 41		"
Poole	— 2 31		"
Plymouth Breakwater	— 0 6		Devonport
Fowey	— 0 29		"
Falmouth	— 0 46		"
Penzance	— 1 13		"
WESTERN COAST OF EUROPE.			
Bayonne	— 0 2		Brest.
Arachon	+ 0 50		"
Bordeaux	+ 3 8		"
Port Navalo... ..	— 0 5		"

MARCH, 1877.

AT APPARENT NOON.

Day of the Week.	Day of the Month.	THE SUN'S				Sidereal Time of the Semi-diameter passing the Meridian.*	Equation of Time, to be added to Apparent Time.	Var. in 1 hour.
		Apparent Right Ascension.	Var. in 1 hour.	Apparent Declination.	Var. in 1 hour.			
		h. m. s.	s.	° ' "	"	m. s.	m. s.	s.
Mon.	19	23 56 24.50	9.108	S. 0 23 21.9	59.27	1 4.52	7 50.69	0.746
Tues.	20	0 0 8.02	9.102	N. 0 0 20.4	59.24	1 4.50	7 32.70	0.752
Wed.	21	0 8 41.40	9.097	0 24 1.7	59.20	1 4.49	7 14.58	0.757

APRIL, 1877.

Added to Subt. from App. Time.								
Frid.	18	1 27 34.52	9.215	9 11 29.4	54.28	1 4.90	0 28.07	0.640
Sat.	14	1 31 15.84	9.229	9 33 6.4	53.84	1 4.95	0 12.88	0.626
Sun.	15	1 34 57.50	9.243	9 54 38.9	53.44	1 5.00	0 1.97	0.611

JUNE, 1877.

Subt. from Added to App. Time.								
Wed.	18	5 27 23.08	10.881	23 14 44.6	8.09	1 8.89	0 18.22	0.524
Thur.	14	5 31 32.31	10.887	23 17 46.4	7.06	1 8.91	0 0.58	0.529
Frid.	15	5 35 41.66	10.891	23 20 28.5	6.08	1 8.93	0 12.17	0.533

AUGUST, 1877.

Added to Subt. from App. Time.								
Tues.	28	10 28 14.50	9.120	9 35 58.9	53.14	1 4.53	0 59.64	0.735
Wed.	29	10 31 58.20	9.106	9 14 38.9	53.52	1 4.53	0 41.84	0.749
Thur.	30	10 35 31.57	9.092	8 53 10.0	53.89	1 4.48	0 23.71	0.762
Frid.	31	10 39 9.68	9.080	8 31 32.3	54.24	1 4.43	0 5.27	0.774
Sat.	32	10 42 47.41	9.068	N. 8 9 46.3	54.58	1 4.39	0 18.45	0.786

SEPTEMBER, 1877.

Subt. from Added to App. Time.								
Sat.	22	11 58 21.90	8.981	N. 0 10 38.7	58.44	1 4.09	7 25.41	0.873
Sun.	23	12 1 57.50	8.986	S. 0 12 44.5	58.48	1 4.11	7 46.31	0.868
Mon.	24	12 5 33.28	8.992	0 36 8.4	58.50	1 4.13	8 7.08	0.862

DECEMBER, 1877.

Subt. from Added to App. Time.								
Sat.	22	18 3 32.61	11.107	23 27 16.7	0.98	1 11.29	1 2.36	1.247
Sun.	23	18 7 59.18	11.107	23 26 40.2	2.11	1 11.29	0 32.43	1.247
Mon.	24	18 12 25.78	11.105	23 25 35.3	3.29	1 11.28	0 2.52	1.245
Tues.	25	18 16 52.23	11.102	23 24 2.2	4.47	1 11.27	0 27.84	1.242
Wed.	26	18 21 18.65	11.099	23 22 0.8	5.65	1 11.26	0 57.11	1.238
Thur.	27	18 25 44.96	11.098	23 19 31.1	6.82	1 11.24	1 26.78	1.233

MARCH, 1877.

AT MEAN NOON.

	Day of the Month.	THE SUN'S			Equation of Time, to be subtracted from Mean Time.	Sidereal Time.
		Apparent Right Ascension.	Apparent Declination.	Semi-diameter.*		
		h. m. s.			m. s.	h. m. s.
n.	19	23 56 28.81	S. 0 28 29.7	13 5.4	7 50.79	23 48 32.52
ss.	20	0 0 1.87	N. 0 0 18.0	16 5.1	7 52.80	23 52 29.07
d.	21	0 8 40.80	0 28 54.6	16 4.8	7 14.67	23 56 25.68

APRIL, 1877.

Subt. from
Added to
Mean Time.

d.	13	1 27 34.45	9 11 29.0	15 58.5	0 28.08	1 27 6.87
.	14	1 31 15.80	9 38 6.2	15 58.2	0 12.88	1 31 2.92
i.	15	1 34 57.50	9 54 34.0	15 57.9	0 1.97	1 34 59.48

JUNE, 1877.

Added to
Subt. from
Mean Time.

d.	13	5 27 23.12	23 14 44.6	15 46.7	0 18.22	5 27 36.84
ir.	14	5 31 32.31	23 17 46.4	15 46.7	0 0.58	5 31 32.89
d.	15	5 35 41.62	23 20 23.5	15 46.6	0 12.17	5 35 29.45

AUGUST, 1877.

Subt. from
Added to
Mean Time.

ss.	28	10 28 14.35	9 35 59.8	15 52.7	0 59.66	10 27 14.69
d.	29	10 31 53.09	9 14 39.5	15 52.9	0 41.85	10 31 11.24
ir.	30	10 35 31.51	8 53 10.3	15 53.2	0 23.71	10 35 7.80
d.	31	10 39 9.62	8 31 32.4	15 53.4	0 5.27	10 39 4.35
.	32	10 42 47.45	N. 8 9 46.1	15 53.6	0 13.46	10 43 0.90

SEPTEMBER, 1877.

Added to
Mean Time.

.	22	11 58 23.01	N. 0 10 31.4	15 59.0	7 25.52	12 5 48.58
i.	23	12 1 58.66	S. 0 12 52.1	15 59.2	7 46.42	12 9 45.09
n.	24	12 5 34.45	0 36 16.3	15 59.5	8 7.19	12 13 41.64

DECEMBER, 1877.

Added to
Subt. from
Mean Time.

.	22	18 8 32.81	23 27 16.7	16 18.0	1 2.34	18 4 35.15
i.	23	18 7 59.28	23 26 40.2	16 18.1	0 32.42	18 8 31.71
n.	24	18 12 25.74	23 25 35.3	16 18.1	0 2.52	18 12 28.26
ss.	25	18 16 52.15	23 24 2.2	16 18.1	0 27.33	18 16 24.82
d.	26	18 21 18.48	23 22 0.8	16 18.2	0 57.09	18 20 21.88
ur.	27	18 25 44.69	23 19 31.2	16 18.2	1 26.75	18 24 17.94

I.

JANUARY, 1884.

AT APPARENT NOON.

Day of the Week.	Day of the Month.	THE SUN'S				Sidereal Time of the Semi-diameter passing the Meridian.*	Equation of Time, to be added to Apparent Time.		Var. in 1 hour.
		Apparent Right Ascension.	Var. in 1 hour.	Apparent Declination.	Var. in 1 hour.				
		h. m. s.	s.			m. s.	m. s.	s.	
Tues.	1	18 45 52.81	11.049	S. 23 1 58.8	12.10	1 11.08	8 38.26	1.189	
Wed.	2	18 50 17.32	11.084	22 56 54.1	18.25	1 11.04	4 6.64	1.176	
Thur.	3	18 54 41.96	11.018	22 51 22.4	14.89	1 10.99	4 34.65	1.159	

FEBRUARY, 1884.

Added to App. Time.

Thur.	7	21 22 29.68	9.991	15 23 16.8	46.71	1 7.60	14 21.80	0.184	
Frid.	8	21 26 29.05	9.957	15 4 28.0	47.85	1 7.49	14 24.11	0.100	
Sat.	9	21 30 27.61	9.923	14 45 24.0	47.97	1 7.38	14 26.11	0.007	

MARCH, 1884.

Added to App. Time.

Wed.	19	23 57 28.78	9.106	S. 0 16 23.6	59.25	1 4.52	7 42.79	0.749	
Thur.	20	0 1 7.20	9.101	N. 0 7 18.1	59.22	1 4.50	7 24.76	0.753	
Frid.	21	0 4 45.58	9.097	0 30 59.0	59.18	1 4.49	7 6.64	0.757	

APRIL, 1884.

Added to Sub. from App. Time.

Sun.	13	1 28 40.90	9.214	9 17 50.6	54.08	1 4.92	0 22.86	0.640	
Mon.	14	1 32 22.21	9.229	9 39 23.9	53.69	1 4.97	0 7.16	0.636	
Tues.	15	1 36 3.88	9.244	10 0 47.6	53.28	1 5.02	0 7.68	0.610	

MAY, 1884.

Sub. from App. Time.

Mon.	19	3 46 29.71	9.982	19 54 50.4	31.58	1 7.56	3 44.10	0.125	
Tues.	20	3 50 29.56	10.005	20 7 18.2	30.78	1 7.63	3 40.81	0.149	
Wed.	21	3 54 29.97	10.029	20 19 25.5	29.87	1 7.71	3 36.97	0.171	

JUNE, 1884.

Sub. from Added to App. Time.

Frid.	13	5 28 38.98	10.377	23 15 22.5	7.77	1 8.90	0 9.82	0.520	
Sat.	14	5 32 48.12	10.384	23 13 16.7	6.75	1 8.92	0 8.23	0.526	
Sun.	15	5 36 57.41	10.390	23 20 46.3	5.72	1 8.94	0 15.92	0.531	

JANUARY, 1884.

II.

AT MEAN NOON.

Day of the Month.	Day of the Week.	THE SUN'S			Equation of Time, to be subtracted from Mean Time.	Sidereal Time.
		<i>Apparent Right Ascension.</i>	<i>Apparent Declination.</i>	<i>Semi- diameter.*</i>		
Tues.	1	h. m. s. 18 45 51.64	S. 23° 1' 59".1	16 18.2	m. s. 8 38.19	h. m. s. 18 42 18.45
Wed.	2	18 50 16.56	22 56 55.0	16 18.2	4 6.56	18 46 10.01
Thur.	3	18 54 41.12	22 51 28.5	16 18.2	4 34.56	18 50 6.56

FEBRUARY, 1884.

Sub. from
Mean Time.

Thur.	7	21 22 27.29	15 23 28.0	16 14.9	14 21.27	21 8 6.01
Frid.	8	21 26 26.66	15 4 39.4	16 14.8	14 24.09	21 12 2.57
Sat.	9	21 30 25.22	15 45 35.6	16 14.6	14 26.10	21 15 59.12

MARCH, 1884.

Sub. from
Mean Time.

Wed.	19	23 57 27.56	S. 0 16 31.2	16 5.3	7 42.89	23 49 44.67
Thur.	20	0 1 6.08	N. 0 7 18.8	16 5.1	7 24.86	23 53 41.22
Frid.	21	0 4 44.50	0 30 52.0	16 4.8	7 6.73	23 57 37.77

APRIL, 1884.

Sub. from
Added to
Mean Time.

Sun.	12	1 28 40.84	9 17 50.3	15 58.5	0 22.36	1 28 18.47
Mon.	14	1 32 22.19	9 39 23.8	15 58.2	0 7.16	1 32 15.03
Tues.	15	1 36 8.90	10 0 37.7	15 57.9	0 7.63	1 36 11.58

MAY, 1884.

Added to
Mean Time.

Mon.	19	3 46 30.38	19 54 52.4	15 50.1	3 44.09	3 50 14.42
Tues.	20	3 50 30.17	20 7 20.1	15 49.9	3 40.80	3 54 10.98
Wed.	21	3 54 30.57	20 19 27.3	15 49.8	3 36.96	3 58 7.53

JUNE, 1884.

Added to
Sub. from
Mean Time.

Frid.	13	5 23 39.01	23 15 22.5	15 46.8	0 9.32	5 23 48.33
Sat.	14	5 32 48.11	23 18 16.7	15 46.7	0 3.23	5 32 44.69
Sun.	15	5 36 57.36	23 20 46.3	15 46.6	0 15.92	5 36 41.44

I.

JULY, 1884.

AT APPARENT NOON.

Day of the Week.	Day of the Month.	THE SUN'S				Sidereal Time of the Semi-diameter passing the Meridian*	Equation of Time, to be added to Apparent Time.	Var. in 1 hour.
		Apparent Right Ascension.	Var. in 1 hour.	Apparent Declination.	Var. in 1 hour.			
		h m s	s.	° ' "	"	m s	m s	s.
Tues.	22	8 8 46.45	9.947	20 9 31.7	30.39	1 7.43	6 11.39	0.091
Wed.	23	8 12 44.90	9.923	19 57 12.3	31.22	1 7.34	6 13.28	0.066
Thur.	24	8 16 42.75	9.898	19 44 33.0	32.05	1 7.26	6 14.58	0.041

AUGUST, 1884.

							Added to Sub. from App. Time.	
Thur.	28	10 29 22.75	9.118	9 29 11.5	53.26	1 4.56	0 56.05	0.737
Frid.	29	10 33 1.39	9.108	9 7 48.8	53.63	1 4.51	0 38.19	0.751
Sat.	30	10 36 39.68	9.088	8 46 17.4	53.98	1 4.46	0 19.98	0.766
Sun.	31	10 40 17.63	9.075	8 24 37.7	54.32	1 4.42	0 1.43	0.780

SEPTEMBER, 1884.

							Sub. from App. Time.	
Mon.	22	11 59 28.78	8.989	N. 0 3 23.4	58.48	1 4.09	7 30.33	0.865
Tues.	23	12 3 4.57	8.994	S. 0 20 0.6	58.51	1 4.11	7 51.04	0.860
Wed.	24	12 6 40.49	9.000	0 43 25.0	58.52	1 4.13	8 11.62	0.854

OCTOBER, 1884.

							Sub. from App. Time.	
Sat.	25	14 1 10.84	9.597	12 20 37.6	51.45	1 6.24	15 53.12	0.259
Sun.	26	14 5 1.52	9.627	12 41 6.7	50.97	1 6.34	15 58.98	0.239
Mon.	27	14 8 52.92	9.657	13 1 24.0	50.46	1 6.45	16 4.11	0.199

NOVEMBER, 1884.

							Sub. from App. Time.	
Frid.	28	16 19 28.15	10.782	21 26 30.8	25.70	1 10.07	11 39.37	0.874
Sat.	29	16 23 46.07	10.760	21 36 35.4	24.68	1 10.16	11 18.07	0.901
Sun.	30	16 28 4.64	10.787	21 46 15.2	23.64	1 10.25	10 56.11	0.928

DECEMBER, 1884.

							Sub. from Added to App. Time.	
Mon.	22	18 4 53.61	11.111	23 26 48.2	1.29	1 11.28	0 53.04	1.251
Tues.	23	18 9 20.27	11.110	23 26 3.0	2.47	1 11.28	0 23.02	1.249
Wed.	24	18 13 46.86	11.106	23 24 49.5	3.65	1 11.27	0 6.93	1.246

JULY, 1884.

AT MEAN NOON.

	Day of the Month.	THE SUN'S			Equation of Time, to be subtracted from Mean Time.	Sidereal Time.
		Apparent Right Ascension.	Apparent Declination.	Semi-diameter.*		
		h. m. s.	° ' "	' "	m. s.	h. m. s.
s.	22	8 8 45.83	20 9 34.8	15 46.8	6 11.38	8 2 34.04
i.	23	8 12 48.87	19 57 15.5	15 46.9	6 13.27	8 6 30.60
r.	24	8 16 41.72	19 44 36.8	15 47.0	6 14.57	8 10 27.15

AUGUST, 1884.

						Sub. from Added to Mean Time.
r.	28	10 29 22.61	9 29 12.4	15 52.8	0 56.06	10 28 26.55
i.	29	10 33 1.80	9 7 49.4	15 53.0	0 38.20	10 32 23.10
.	30	10 36 39.63	8 46 17.7	15 53.2	0 19.98	10 36 19.65
.	31	10 40 17.63	8 24 37.7	15 53.5	0 1.43	10 40 16.20

SEPTEMBER, 1884.

						Added to Mean Time.
i.	22	11 59 29.91	N. 0 8 16.1	15 59.0	7 30.44	12 7 0.85
s.	23	12 8 5.75	S. 0 20 9.2	15 59.2	7 51.15	12 10 56.90
i.	24	12 6 41.72	0 43 33.0	15 59.5	8 11.73	12 14 53.45

OCTOBER, 1884.

						Added to Mean Time.
.	25	14 1 13.38	12 20 51.2	16 8.0	15 53.19	14 17 6.57
.	26	14 5 4.09	12 41 20.3	16 8.3	15 59.04	14 21 3.12
i.	27	14 8 55.51	13 1 37.5	16 8.5	16 4.17	14 24 59.68

NOVEMBER, 1884.

						Added to Mean Time.
i.	28	16 19 30.24	21 26 35.8	16 15.4	11 39.20	16 31 9.43
.	29	16 23 48.09	21 36 40.0	16 15.6	11 17.90	16 35 5.99
.	30	16 28 6.60	21 46 19.5	16 15.8	10 55.94	16 39 2.55

DECEMBER, 1884.

						Added to Sub. from Mean Time.
i.	22	18 4 53.78	23 26 48.2	16 18.0	0 53.02	18 5 46.80
s.	23	18 9 20.84	23 26 3.0	16 18.0	0 23.01	18 9 43.86
i.	24	18 13 46.84	23 24 49.5	16 18.1	0 6.93	18 13 39.91

TABLE.
DECLINATION OF THE FIXED STARS.

DATE, 1877.		
MONTH AND DAY.	STAR'S NAME.	DECLINATION.
August 30th. ...	α Coronæ (Alphacca)	27 7 45 N.
February 11th. ...	α Pegasi (Markab)	14 32 36 N.
January 20th ...	α Piscis Australis (Fomalhaut)	30 16 36 S.
May 7th. ...	α Orionis (Betelgeuse)	7 23 1 N.
December 8th. ...	α Lyæ (Vega)	38 40 15 N.
June 12th. ...	α Scorpii (Antares)	26 9 41 S.
January 11th. ...	γ Pegasi (Algenib).....	14 32 25 N.
February 20th. ...	α Eridani (Achernar)	57 49 49 S.
March 9th. ...	α Tauri (Aldebaran)	16 16 21 N.
April 21st. ...	α Aurigæ (Capella)	45 52 40 N.
May 18th. ...	β Orionis (Rigel)	8 20 28 S.
June 10th. ...	α Argus (Canopus)	52 38 18 S.
July 28th. ...	α Canis Majoris (Sirius)	16 33 35 S.
August 19th ...	α^* Geminorum (Castor)	32 8 17 N.
September 6th. ...	α Canis Minoris (Procyon)	5 31 8 N.
October 16th. ...	β Geminorum (Pollux)	28 18 1 N.
November 25th. ...	α Leonis (Regulus)	12 31 39 N.
December 17th. ...	α Virginis (Spica)	10 38 23 S.

Exn. 4.

Rotation No.

Port of _____

EXAMINATION PAPER III.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A
SECOND MATE.

paper is to be used at the above Port this _____ day of _____

ce for minor
rections.

1.—Multiply 943 by 547, by common logarithms.

943 log.	2.974512
547 log.	2.737987
515821.43 log.	5.712499
	81
	84)1800.000(21.428
	168
	120
	84
	360
	336
	240
	168
	720
	672

The answer is carried to three places of decimals, and the last figure being 5, or above it, 1 is added to the preceding figure, thus making the answer nearly correct to the second decimal place. If the last figure had been below 5, nothing would be added to the preceding figure.

2.—Divide .5006 by .221 by common logarithms.

		By common indices.	By negative indices.
.5006	log.	9.699491	<u>1.699491</u>
.221	log.	9.344392	<u>1.344392</u>
2.265	log.	0.355099	0.355099

By "Bergen's Navigation", page 18, Art. 19, the common index is 9, and by the Rule on page 27, the negative index is 1.

The lower negative index, (in division of logarithms) is changed into positive; and — 1 + 1 destroy each other, or their sum is 0.

The Candidate should sign his name in full at the foot of every page.

PAPER III. EXAMPLES IN DAYS' WORKS.

Space for minor corrections.

N
W ————— E
S
S. 33° 45' W.
Dev. 15° E. }
Var. 14 E. } 29 0 E.
S. 62 45 W.
S. 50° 38' E.
Leeway 14 4
S. 64 42 E.
Dev. 15° E. }
Var. 14 E. } 29 0 E.
S. 35 42 E.
S. 67° 30' E.
Leeway 16 53
S. 84 23 E.
Dev. 18° E. }
Var. 14 E. } 32 0 E.
S. 52 23 E.
S. 84° 23' E.
Leeway 25 19
S. 109 42 E.
Dev. 20° E. }
Var. 14 E. } 34 0 E.
S. 75 42 E.
N. 78° 45' E.
Leeway 28 8
N. 50 37 E.
Dev. 20° E. }
Var. 14 E. } 34 0 E.
N. 84 37 E.
S. 67° 30' W.
Leeway 8 26
S. 75 56 W.
Dev. 16° W. }
Var. 14 E. } 2 0 W.
S. 78 56 W.
N. 67° 30' W.
Leeway 5 38
N. 61 52 W.
Dev. 24° W. }
Var. 14 E. } 10 0 W.
N. 71 52 W.
S. 28° 8' E.
Var. 14 0 E.
S. 14 8 E.

Hrs.	Courses.	Knts	10ths	Winds.	Lee way.	Devia- tion.	Remarks.
1	S. E. ½ E.	5	1	S. S. W.	1½	15° E.	A point, in Lat. 50° 14' N., Long. 179° 5' W. bearing by Compass N. E. by N.
2		5	2				
3		5	3				
4		5	4				
5	E. S. E.	6	4	South.	1½	18° E.	Dist. 17 miles. (Ship's head S. E. ½ E., Deviation as per log.)
6		7	3				
7		7	5				
8		7	8				
9	E. ½ S.	7	5	S. S. E.	2½	20° E.	Variation 14° E.
10		6	4				
11		5	5				
12		4	6				
1	E. by N.	4	1	S. E. by S.	2½	20° E.	A current } set correct } SSE ½ E. magnetic. }
2		4	2				
3		3	7				
4		2	0				
5	W. S. W.	2	1	S. by E.	¾	16° W	34 miles from the time the departure was taken to the end of the day.
6		2	4				
7		3	3				
8		4	2				
9	W. N. W.	5	4	S. W.	½	24° W	
10		6	6				
11		7	6				
12		8	4				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

Corrected Courses.	Dist.	N.	S.	E.	W.
S 68° W	17		7-7		15-1
S 86 E	21		17-0	12-3	
S 52 E	29		17-9	22-9	
S 76 E	24		5-8	23-3	
N 85 E	14	1-2		13-9	
S 74 W	12		3-3		11-5
N 72 W	28	8-7			26-6
S 14 E	34		33-0	8-2	
		9-9	84-7	80-6	53-2
			9-9	53-2	
			6,0)7,4-8	27-4	
			1 14-8		

Lat. left 50° 14' N Long. left 179° 5' W
Diff. lat. 1 15 S D.L. 42 E

Lat. in 48 59 N Long. in 178 23 W

2)99 13

Mid. lat. 49 36

Mid. lat. 49° as course, dep. 27-6 in lat. col. give dist. 42
do. 50 do. 27-6 do. do. 43

2)85

D. L. 42-5

D.L. 74-7, dep. 28-7, give course 21, Distance 80; hence the Course S. 21° E., Distance 80 miles.

PAPER III.

EXAMINATION FOR SECOND MATES—Continued.

for Minor
rections.

Remarks.—By logs D.L. 42-28, Course 20° 7' E., Distance 79.66 miles.

4.—1877, April 18th, in longitude 88° W. The observed meridian altitude of the Sun's Lower Limb was 64° 18' 20" bearing South, index error — 1' 20", height of eye 19 feet.

Required the Latitude.

	d.	h.	m.	s.		
A.T.S., April ..	18	0	0	0	Long. ..	88 0 W
Long. ..	+	2	32	0		4
A.T.G., April ..	18	2	32	0	6,0)15,2	0
				2.5		2° 32' 0"

Var.
54°28
2.5
27115
10846
0)18,5-575
2 15.6

Dec.	
9 11 29 N	Obs. alt. .. 64 18 20 S
+ 2 16	I.E. — 1 20
9 18 45 N	64 17 0
	Dip. — 4 17
	64 12 48
	Corr. — 0 24
	64 12 19
	Sem. + 15 59
	True alt. .. 64 28 18
	90 0 0
	Z.D. 25 31 42 N
	Dec. 9 18 45 N
	Latitude .. 84 45 27 North

5.—In latitude 57° 42' the departure made good was 110 miles.

Required the difference of Longitude by parallel sailing.

Lat.	57 42	sec.	0.272172
Dep.	110	log.	2.041898
Diff. long. ..	205.9	log.	2.313545

The Candidate should sign his name in full at the foot of every page,

6.—Required the Course and Distance from A to B by calculation on Mercator's Principle.

Lat. of A	2° 36' N	Long.	180° 8' E
Lat. of B	0 25 S	Long.	82 26 W
A Lat.	2° 36' N	m. pts	156
B Lat.	0 25 S	m. pts	25
		long.	180° 8' E
			82 26 W
	8 1	m.d.l.	181
	60		212 84
			360 0
D. Lat.	181 S		147 26
			60
		D. Long.	8846 E
D. Long.	8846	log. + 10	18-946747
M.D.L.	181	log.	2-257679
Course	88° 50'	tan.	11-689068
Course	88° 50'	sec.	1-691206
D. Lat.	181	log.	2-257679
Distance	8890	log.	8-948885

Course S 88° 50' E. Distance 8890 miles.

Remarks.—The lats. of A and B are of different names, in this case they must be added together, and the mer. pts. must also be added together.

The longs. of A and B are also of different names, and they must be added together; their sum is above 180, in this case it must be taken from 360°; the diff. long. must be E the same as the long. of A.

By Articles 10, 11, and 12 of the Notice to Candidates published by the Board of Trade, dated 27th September, 1880, Candidates are expected to bring their answers "not to exceed a margin of one mile of position from a correct result," except in Summer's Method where 2½ miles may be allowed.

For all Grades except extra master, "the logarithms to the nearest minute will be sufficiently correct," except in finding hour angles where they must be taken out for seconds.

The above question wrought out to seconds.

Course	88° 49' 40"	tan.	11-689068	
			4954	
			10270)411400(40	
			41080	
			600	
Course	88° 49' 0"	sec.	1-685046	Diff. 10266
			4106	40
Course	88 49 40	sec.	1-689152	
D. Lat.	181	log.	2-257679	4106,40
Distance	8848	log.	8-946831	
Distance by minutes of arc	8890 miles			
Distance by seconds of arc	8848 miles			
Difference	42 miles			

By working to minutes of arc, the Distance will generally be correct to within 2 miles of Position, as is evident by comparing the answers to the questions on pages 107 and 109, *Bergen's Navigation*; but if the distance be required to be correct to 1 mile of Position, the question should be wrought to seconds of arc; as is evident from the above solutions.

Exn. 5.

Port of _____

Rotation No.

EXAMINATION PAPER III.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A
SECOND MATE.

be used at the above Port this _____ day of _____ 18

—A Candidate for a Second Mate's Certificate of Competency will be required to work the Questions in Paper Exn. 4, in addition to the Questions in this Paper.

for Minor
rections.

1.—1880, June 2nd. Find the time of High Water at Bayonne, A.M. and P.M.

	d. h. m.	d. h. m.
Stand. Brest, June	2 11 32 A.M.	3 0 5 A.M.
Constant Bayonne	— 0 2	— 0 2
H.W. Bayonne ..	2 11 30 A.M.	3 0 3 A.M.

Remarks.—The A.M. tide comes out first; work from 3d. Oh. 5m. A.M., the next tide in the book, the result is June 3d. Oh. 3m. A.M., so that there is no P.M. tide on the 2nd of June.

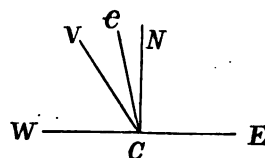
2.—1876, December 6th, at Oh. 15m. A.M. App. T. Ship in latitude $67^{\circ} 27' S$ longitude $17^{\circ} 16' E$. The Sun's Magnetic Amplitude was $S 2^{\circ} W$.

Required the true Amplitude, and Error of the Compass; and supposing the Variation to be $22^{\circ} 10' W$, required the Deviation of the Compass for that position of the Ship's Head.

	d. h. m. s.	
Civil A.T.S., December	6 0 15 0 A.M.	Long. $17^{\circ} 16' E$
	— 1+12	4
Astron. A.T.S., December..	5 12 15 0	6,0)6,9 4
Long. E...	1 9 4	1 9 4
	5 11 5 56	
	11.1	

Var.

18.37	22 28 7 S	Lat..... $67^{\circ} 27'$	sec. 0.416246
11.1	+ 8 24	Dec..... 22 32	sin. 9.583449
1837	22 31 31 S	True amp. E. 87 51 S	sin. 9.999695
20207		Or 180 0	
0)20,3.907		True amp. W 92 9 S	
8 23.9		Mag. amp. W 81 34 S	
		Error 10 25 W	
		Var. 22 10 W	
		Deviation .. 11 35 East	



e right of V.
Deviation E.

The Candidate should sign his name in full at the foot of every page.

PAPER III.

EXAMINATION FOR SECOND MATES—Continued.

Space for Minor Corrections.

Sin.	
22 31 0	9.583145
	+ 157
22 31 31	9.583302
diff. 508	
81	
508	
1524	
157,48	

Remarks.—Civil time is reduced to astronomical time by adding 12 to the hours, and taking 1 from the days. It being A.M., and the dec. S, the true Amp. is reckoned from E towards S.

S $\frac{1}{2}$ W is equivalent to W 7 $\frac{1}{2}$ S, which in degrees is W. 81° 34' S. The true and mag. amps. are brought to the same name by taking the true from 180°, and changing its name.

In high latitudes a small difference in the declination will cause a great difference in the amplitude; as will be shewn by working the above question to seconds.

Lat.....	67 27 0	sec.	0.416246
Dec.	22 31 31	sin.	9.583302
To seconds. True amp. E..	87 23 S	sin.	9.999548
To minutes. True amp. E	87 51 S		
Difference	28		

By working to minutes the answer will generally be correct to 1 minute of arc.

3.—1877, August 31st, P.M., at Ship in latitude 36° 18' S.

The observed altitude of the Sun's L.L. was 24° 47' 30", I.E. +1' 30", height of eye 18 feet. Time by Chronometer, August 31d. 11h. 16m. 14s., which was 1m. 14s. fast for mean noon at Greenwich, on March 29th, and on May 28th, was 0m. 16s. slow.

Required the longitude by Chronometer.

To find daily rate.

Mar. 31	m. s.
Mar. 29	1 14 F.
Mar. 2	
April 30	
May	0 16 S.
60	1 30
60	
60)9,0	
Losing daily.	1.5
Var.	
54.24	
11.3	
16272	
59664	
6,0)61,2.912	
10 12.9	

T. Chron., Ang. ..	d. h. m. s.	May ..	d.
Slow	81 11 16 14	May ..	81
	+ 0 16	May ..	28
			11
	81 11 16 30	May ..	3
Lost	+ 2 23	June ..	30
		July ..	31 h.
M.T.G., Aug.	81 11 18 53	Aug. ...	31 11
	11.3		95 11
			6,0)14,3.160
			2 23.1

Dec.	Eq. T.	Var.
8 31 32 N	+ 0 5.27	0.774
— 10 18	— 3.75	11.3
8 21 19 N	— 0 3.48	2322
90 0 0		8514
P.D... 98 21 19		8.7462

The Candidate should sign his name in full at the foot of every page.

PAPER III.

EXAMINATION FOR SECOND MATES—Continued.

Space for Minor
Corrections.

Cosec.	
21' 0"	0·004628
	+ 6
21 19	0·004634
Diff.	81
	19
	279
	31
	5,89

Cos.	
49 0	9·247428
	— 23
49 2	9·247455
Diff.	1172
	2
	23,46

Sin.	
50 0	9·912477
	+ 24
50 16	9·912501
Diff.	148
	16
	888
	148
	23,68

Obs. alt. ..	24 47 30	Alt. ..	24 58 46	
I.E.	+ 1 30	Lat. ..	36 18 0	sec. .. 0·093704
		P.D. ..	98 21 19	cosec. 0·004634
	24 49 0			
Dip.	— 4 11		2)159 38 5	
	24 44 49		79 49 2	cos. .. 9·247455
Corr.	— 1 56		54 50 16	sin. .. 9·912501
	24 42 53			
Sem.	+ 15 53	h. m. s.		
		H.A. ..	3 21 35	log. .. 9·258294
True alt. ..	24 58 46	Eq. T. ..	— 3	10
				19 = 8s.
	M.T.S., Aug. ..	81 3 21 32		
	M.T.C., Aug. ..	81 11 18 53		
		7 57 21		
		60 60		
		4)477 81 60		
	Longitude	119 20 15 West		

Remarks.—There is a change of precept in the Equation of Time between the 31st Aug. and the 32nd, or 1st of Sept. on Page II. of the month, on the 31st it is 0m. 5·27, and on page I. of the month a black line is drawn below the equation on the 31st; and by the precept at the top of the page all the equations above that line are to be added, and those below are to be subtracted.

In order to find the equation at the time of observation, mark the Eq. T. in the 31st, +, and the correction of the equation —; take their difference and mark it with the sign of the greater. In this instance it is —,

The Candidate should sign his name in full at the foot of every page.

Exam. 6.

Port of _____

Rotation No.

EXAMINATION PAPER III.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A

FIRST MATE.

Space for Minor
Corrections.

L.—1877. March 21st. Mean Time at Ship 3h 45m P.M., latitude $40^{\circ} 1' 8''$, longitude $179^{\circ} 35' E$. The Sun's bearing by Compass SW by W $\frac{1}{2}$ W, altitude $26^{\circ} 12'$. Height of the eye 16 feet. I. H. $+ 1' 10''$. Required the True Azimuth, and Error of the Compass; and supposing the Variation to be $15^{\circ} 30' E$, required the Deviation of the Compass for that position of the Ship's head, both from the Altitude and by the True Azimuth Tables.

	L.	L.	M.	S.	
M.P.S. Mar...	21	3	45	0	Long. $179^{\circ} 35' E$
Long.	—	11	58	20	4

M.P.G. Mar...	20	15	46	40	6,077.8 20
21	0	0	0		
				+ 13 20	11 58 20

+2

var.

Dec.

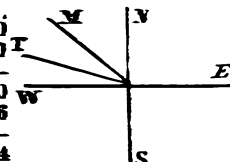
$$\begin{array}{r} 53-20 \\ 8-2 \\ \hline 11840 \\ 47360 \\ \hline 6,048,5440 \\ 854 \end{array}$$

$$\begin{array}{r} 0^{\circ} 32' 56'' N \\ - 8' 5'' \\ \hline 0^{\circ} 15' 50'' N \\ 90 0 0 \end{array}$$

P.D. 90 15 50

Figure for Error.

Obs. alt...	26	1	0
I.H.	+	1	10
	26	2	10
Dip	—	3	56
	26	58	14
Corr.	—	1	50
	26	56	24
Sun.	+	16	15



True alt... 26 12 29 Figure for Deviation.

BY SUN'S ALTITUDE.

Alt...	26	12	29	sec. 0-047082
Lat...	40	1	0	sec. 0-115852
P.D.	90	15	50	

2)156 29 19

$$\begin{array}{r} 78\ 14\ 39 \\ 12\ 1\ 11 \\ \hline \end{array}$$

$$\begin{array}{r} \cos. 9-908867 \\ \cos. 9-990678 \end{array}$$

2)19-463179

$$\begin{array}{r} 32\ 34\ 24 \\ 2 \end{array}$$

$$\begin{array}{r} \sin. 9-731069 \\ 00 \end{array}$$

65 8 48

$$\begin{array}{r} 329)8000(24 \\ 658 \end{array}$$

T. az. N 65 9 W.

M. az. N 64 41 W.

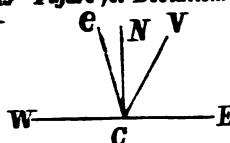
1420

1316

Err. 0 28 W.

Var. 15 30 E.

Deviation 15 58 W.



T to left M, error W.

E left of V, deviation W;
or, conceive the name of
the var. to change from
E to W and add.

EXAMINATION FOR FIRST MATES.—Continued.

space for Minor
Corrections.

BY AZIMUTH TABLES.

M.T.S.	h. m.	p.m.	Eq. T.	m. s.	
Eq. T.	3 45			7 14	75
	— 7			6	8
	3 38			— 7 20	6 00
h. m.					
Lat. 40 S.; Dec. 0° 16' N, and A.T.S. 3 36 give True az. S 115 2 W					
A.T.S. 3 40 „ S 114 14 W					
2) 229 16					
True az. S 114 38 W					
180 0					
True az. N 65 22 W					
Mag. az. 64 41 W					
Err. 0 41 W					
Var. 15 30 E					
Deviation 16 11 W					

Remarks.—By working to seconds of arc the True Azimuth is N 65° 10' W and the Deviation 15° 59' W.

The Candidate should sign his name in full at the foot of every page.

PAPER III.

EXAMINATION FOR FIRST MATES.—Continued.

Space for Minor
Corrections.

2.—1877, June 14th, A.M. at Ship, Lat. by account, $57^{\circ} 43' N$, Lon $10^{\circ} 14' W$, the observed altitude of the Sun's L.L. South of t observer was $55^{\circ} 18'$, height of eye 18 feet. Time by watch, 1: 2h. 16m. 44s., which had been found to be fast of apparent time ship, 2h. 28m. 20s. The difference of Longitude made to the W was $41\frac{1}{4}'$ after the error on Apparent Time at Ship was determined. Required the Latitude by the Reduction to the Meridian.

	d.	h.	m.	s.			
T. Watch, June 14	2	16	44		D.L.	41.5	Long. $10\ 14' W$
Fast		2	28	20		4	4
	13	23	48	24			
D.L. W	—		2	46	6,0	$16,6.0$	6,0) $4,0\ 56$
					2	46	0 40 56
A.T.S. June 13	23	45	38				
Long. W	+	0	40	56	h. m. s.		
					24	0	0
A.T.G. June 14	0	26	84		28	45	88
		0	4			14	22 T. from noon.

var. Dec,

$23\ 17\ 46N$	Obs. Alt.	$55\ 18\ 08$
$+ \quad 8$	Dip	$- \quad 4\ 11$
$23\ 17\ 49N$		$55\ 13\ 49$
	Cor.	$- \quad 0\ 35$
		$55\ 13\ 14$
	Sem.	$+ \quad 15\ 47$
	True Alt.	$55\ 29\ 1$

Rising.

m. s.	
14 20	2-29116
2	238
14 22	2-29354

T. from N.	m.	14 22	Rising	2-29354
Lat. Acc.	57	43N	cos.	9-727628
Dec.	23	18N	cos.	9-963054
			constant	1.
			964 log	2-984222
True Alt...	55	29S Nat.	sin.	823961
Z. D.	34	25N Nat.	cos.	824925
Dec.	23	18N		
Latitude	57	43 North		

Remarks.—By working to seconds of arc the Latitude is $57^{\circ} 42' 27'' N$.

The Candidate should sign his name in full at the foot of every page.

Exn. 7.
(late E. F 4.)

Rotation No.

Port of _____

EXAMINATION PAPER III.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A

MASTER ORDINARY.

To be used at the above Port this _____ day of _____ 188

N.B.—A Candidate for an Ordinary Master's Certificate of Competency will be required to work the Questions in Papers Exn. 4, Exn. 5, Exn. 6, in addition to the Questions in this Paper.

Space for Minor
Corrections.

1.—1877, January 20th. The observed Meridian Altitude of the Star, α Piscis Australis (Fomalhaut), bearing South was $86^{\circ} 18' 45''$, I.E.— $1' 20''$, height of the eye 19 feet.

Required the Latitude.

Obs. alt	$86^{\circ} 18' 45''$ S
I.E.	— 1 20
	$86 17 25$
Dip.	— 4 17
	$86 18 8$
Ref.	— 1 19
True alt.	$86 11 49$
	$90 0 0$
Z.D.	$58 48 11$ N
Dec.	$80 16 36$ S
Latitude.....	$28 31 35$ North

The Candidate should sign his name in full at the foot of every page.

Exn. 4.

Port of _____

Rotation No.

EXAMINATION PAPER IV.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A

SECOND MATE.

This paper is to be used at the above Port this _____ day of _____ 18____

Space for Minor
Corrections.1.—Multiply $\cdot 00642$ by $\cdot 00716$ by common logarithms.

By common indices. By negative indices.

 $\cdot 00642$ log. $7\cdot 807585$ $\overline{8}\cdot 807585$ $\cdot 00716$ log. $7\cdot 854918$ $\overline{8}\cdot 854918$ $\cdot 00004597$ log. $5\cdot 662448$ $\overline{5}\cdot 662448$

Here, the sum of the common indices + 1 is 15, reject 10 from this, the remainder, 5, is the common index of the product, hence, by Art. 19, four ciphers must be prefixed to the natural number found from the Table. Again, take the 1 carried from $\overline{8}$, the sum of the negative indices, and the remainder $\overline{5}$ is the negative index of the product; hence by the Rule, page 27, four ciphers must be prefixed, the same as before.

2.—Divide $\cdot 0947$ by $\cdot 00421$ by common logarithms.

By common Indices. By negative Indices.

 $\cdot 0947$ log. $8\cdot 976850$ $\overline{2}\cdot 976850$ $\cdot 00421$ log. $7\cdot 624282$ $\overline{8}\cdot 624282$ $22\cdot 49$ log. $1\cdot 852068$ $1\cdot 852068$

Here, the divisor being less than the dividend, therefore the common index, 1, of the quotient must refer to two integers before the decimal point.

The negative sign of the divisor must be changed to the positive sign, and the sum of $\overline{2}$, and + 8 is + 1 or 1.

The Candidate should sign his name in full at the foot of every page.

PAPER IV.

EXAMINATION FOR SECOND MATES—Continued.

8.—

Space for Minor
corrections.

N	
W	E
S	
N. 75° 8' E	
14 E } 82 0 E	
18 E }	
N. 105 8 E	
180 0	
S. 74 52 E	
N. 11° 15' E	
L. 2 49	
N. 8 26 E	
14 E } 82 0 E	
18 E }	
N. 40 26 E	
N. 5° 38' W	
L. 5 38	
N. 11 16' W	
14 E } 29 0 E	
15 E }	
N. 17 44 E	
S. 84° 28' E	
L. 2 49	
S. 81 34 E	
14 E } 43 0 E	
29 E }	
S. 88 34 E	
N. 67° 30' E	
L. 2 49	
N. 70 19 E	
14 E } 38 0 E	
24 E }	
N. 108 19 E	
180 0	
S. 71 41 E	
N. 45° 0' E	
L. 5 38 E	
N. 50 38 E	
14 E } 39 0 E	
24 E }	
N. 89 38 E	
S. 0 0' W	
L. 8 26	
S. 8 26 W	
14 E } 5 0 W	
19 W }	
S. 8 26 W	
N. 84 23' E	
V. 14 0' E	
N. 98 23 E	
180 0	
S. 81 37 E	

Hrs.	Courses.	Knts.	10ths	Winds.	Lee-way.	Dev.	Remarks:
1	N by E	6	3	E by N	$\frac{1}{4}$	18° E	A point East Cape Islet, in Lat. 37° 40' S Long. 178° 36' E
2		5	4				
3		5	6				
4		5	7				
5	N $\frac{1}{2}$ W	6	2	ENE	$\frac{1}{2}$	15° E	bearing by Compass W by S $\frac{1}{2}$ S
6		6	1				
7		5	9				
8		4	8				
9	E $\frac{1}{2}$ S	5	2	NNE $\frac{1}{2}$ E	$\frac{1}{4}$	29° E	(Ship's Head N by E Deviation as per log) Dist. 30 miles.
10		6	3				
11		6	6				
12		7	9				
1	ENE	7	2	N	$\frac{1}{4}$	24° E	Variation 14° E
2		6	5				
3		6	4				
4		5	9				
5	NE	5	7	NNW	$\frac{1}{4}$	25° E	A current set } E $\frac{1}{2}$ N Correct Mag- } netic.
6		5	8				
7		5	9				
8		6	6				
9	South	3	4	ESE	$\frac{1}{4}$	19° W	12 miles from the time of departure was taken to the end of the day.
10		3	4				
11		3	4				
12		3	8				

Correct the Courses for Deviation, Variation and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

Corrected Courses.	Dist.	N.	S.	E.	W.
S 75° E	30		7.8	29.0	
N 40 E	23	17.6		14.8	
N 18 E	23	21.9		7.1	
S 39 E	26		20.2	16.4	
S 72 E	26		8.0	24.7	
East	24			24.0	
S 8 W	14		14.0		0.7
S 82 E	12		1.7	11.9	
		39.5	51.7	127.9	0.7
			39.5	0.7	
			12.2	127.2	

Lat. left 37° 40' S
D.L. 12 S

Long. left 178° 36' E
D.L. 2 41 E

Lat. in 37 52 S

Long. in 181 17 E
360 0

2) 75 32

Or Long, in 178 43 W

37 46

TO FIND THE DIFF. LONG.

Mid. lat. 37° dep., 127.0 in lat. col., give 159 dist.
38 126.9 161

4) 2

0.5 subtract from 161
6,0) 16,0.5

Diff. long. 2 40.5

PAPER IV.

EXAMINATION FOR SECOND MATES—Continued.

Space for Minor
Corrections.

TO FIND THE COURSE AND DISTANCE.

127·3 dep., 13·4 lat., give course 84°, dist. 128

127·5 dep., 11·2 lat., give course 85°, dist. 128

Hence, Course S 84½ E, Distance 128 miles.

Remarks.—The mid. lat. 37° 46' may be considered as 37½. Proceed as in the question, with the nearest dep. in Table II., and course 37° and 38° respectively. To find the corresponding dists., take the difference of these dists., divide this difference by 4, and subtract the quotient from 161, the result is the diff. long.

In finding the course and distance in Table II., be guided principally by the higher number, whether it be lat. or dep.

By Logs., the diff. long. 2° 40'·9, course 84° 31', and distance 127·7.

4.—1877, June 15th, in longitude 87° E, the observed meridian altitude of the Sun's Lower Limb was 56° 14' 10" bearing North, index error 0, height of eye 15 feet.

Required the Latitude.

	d.	h.	m.	s.		Long.	87°	0'	E
A.T.S., June ..	15	0	0	0					
Long. E	—	5	48	0					4
A.T.G. June ..	14	18	12	0		6,0)	34,8	0	
			5·8				5	48	0

Var.

6·03
5·8

4824

3015

34·974

Dec.

28 20 24 N

— 85

23 19 49 N

obs. alt. 56 14 10 N

dip. — 8 49

corr. 56 10 21

— 84

sem. 56 9 47

+ 15 47

True alt. 56 25 34

90 0 0

Z.D. 33 34 26 S

Dec. 23 19 49 N

Latitude 10 14 37 South

5.—In latitude in 58° 8' the departure made good was 44 miles.

Required the difference of Longitude by parallel sailing.

Lat. 58° 8' sec. 0·277412

Dep. 44 log 1·643453

Diff. long. 83·34 log. 1·920865

The Candidate should sign his name in full at the foot of every page.

PAPER IV.

EXAMINATION FOR SECOND MATES—Continued.

for Minor
actions.

6.—Required the Course and Distance from A to B by calculation on Mercator's principle.

	Lat. of A	11° 50' N		Long.	51° 16' E
	Lat. of B	82 8 S		Long.	115° 46 E
A Lat.	11° 50' N	m. pts.	715	Long.	51° 16' E
B Lat.	82 8 S	m. pts.	2082	Long.	115 46 E
	<u>48 53</u>	m.d.l.	<u>2747</u>		<u>64 80</u>
	60				60
D Lat.	<u>2688 S</u>			D. Long.	<u>8870 E</u>
D Long.	8870 log.	+	10	18-587711	
M.D.L	2747 log.			8-488859	
Course	54° 38' tan.			<u>10-148852</u>	
Course	54° 38' sec.			0-247466	
D. Lat.	2688 log.			<u>8-420451</u>	
Distance	4549 log.			<u>8-657917</u>	
Course S	54° 38' E	Distance	4549 miles.		

Remarks. The Latitude of A to B being of different names take their sum for the diff. lat.

Also, take sum of the mer. pts. for the mer. diff. lat..

By working to seconds the course is S 54° 47' 56" E
Distance 4549 miles.

Exn. 5.

Port of _____

Rotation No.

EXAMINATION PAPER IV.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A
SECOND MATE.Space for Minor
Corrections.

1.—1880, April 2nd, find the time of High Water at Fishguard, A.M. and P.M.

	d.	h.	m.	d.	h.	m.
Standard, Holyhead, April 2	3	28	P.M.	2	2	50 A.M.
Constant, Fishguard,	—	3	15	—	3	15
H.W. Fishguard, April 2	0	13	P.M.	1	11	35 P.M.

No A.M. Tide.

2.—1877, August 28th, at 5h. 27m. P.M., App. T. Ship, in latitude $43^{\circ} 16'S$, longitude $160^{\circ}W$, the Sun's Magnetic Amplitude was $W 18$; required the True Amplitude, and Error of the Compass; and supposing the Variation to be $15^{\circ} 10'E$, required the Deviation of the Compass for that position of the Ship's Head.

	d.	h.	m.	s.	
A.T.S. Aug. 28	5	27	0	P.M.	Long. $160^{\circ} 0'W$.
Long. W	+	10	40	0	4
A.T.G. Aug. 28	16	7	0		6,0)6,40 0
	29	0	0	0	
					10 40 0
					7 53
					7.9

Var.

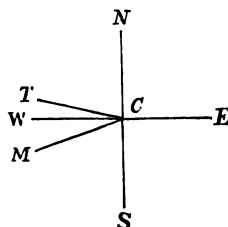
53.52
7.948168
87464

6,0)42,2-808

7 2.8

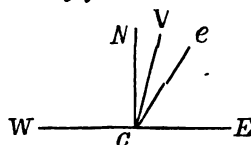
9 14 89N.	Lat. 48 16 sec.	0.187766
+ 7 8	Dec. 9 22 sin.	9.211526
9 21 42N	True Amp. W 12 55N sin.	9.349292
	Mag. Amp. W 2 49S	
	Err. 15 44E	
	Var. 15 10E	
	Deviation 0 34E	

Fig. for Error.



T right of M, Error E.

Fig. for Deviation.



e right of V, Deviation E, or conceive E Var. to be changed into W, take the difference and give it the name of the greater, namely E.

Remarks.—By working to seconds the Deviation is $0^{\circ} 33' 14''E$.
By working from the Afternoon Tide on the 2nd April, at Holyhead, the P.M. Tide at Fishguard is obtained; then by working from the tide before the one taken out of the Table, the tide before the P.M. tide at Fishguard is on the 1st of April; thus there is no A.M. Tide at Fishguard on the 2nd April.

EXAMINATION FOR SECOND MATES.—Continued.

Space for Minor
Corrections.

To find Daily Rate.

Mar. 21 m. s.
Mar. 31 1 14F.Mar. 10
Apr. 30 2 34F.40 1 20
— 60

40)90(2

Gaining Daily.

var.

58.44
11.211688
64284

6,0)65,4.528

10 54.5

76 4 0 } cos.
9.981648
93

76 4 11 } 9.981550

Diff. 849

11

93.89

9.—1877, September 22nd, P.M. at Ship in latitude $81^{\circ} 2' N$, the observed altitude of the Sun's L.L. was $80^{\circ} 56'$; height of eye 21 feet. Time by a Chronometer Sept. 22d. 11h. 18m., which was 1m. 14s. fast for mean noon at Greenwich on March 21st, and on April 30th, was 2m. 34s. fast. Required the longitude by Chronometer.

	d.	h.	m.	s.		
T. Chron., Sept.	22	11	18	0	April 30	11
Fast	—	2	34		April 30	04
	22	11	15	26	April 0	145.44
Gained	—	4	51		May 31	2
M.T.G., Sept.	22	11	10	35	June 30	6,0)29,0.88
	11.2				July 31	4 50.8
					Aug. 31	
					Sept. 22	11
					145	11

var.	Dec.	Eq. T.	var.
	0 10 31N	m. s.	
	0 10 55S	— 7 25.52	.873
		+ 9.78	11.2
	0 0 24S	— 7 35.80	1746
	90 0 0		9603
P.D. 90 0 24			9.7776

Obs. Alt.	80 56 0	Alt.	81 5 59	
Dip	— 4 31	Lat.	81 2 0	sec. 0.067086
	30 51 29	P.D. 90 0 24 cosec.	0.000000	
Corr.	— 1 29	2)152 8 23		
	30 50 0			
Semi.	+ 15 59	76 4 11	cos. 9.981550	
		44 58 12	sin. 9.849257	
True Alt.	81 5 59			
		h. m. s.		
		H.A. 8 31 42	log 9.297893	
		Eq T — 7 35	79	

M.T.S. Sept. 22 3 24 7
M.T.G. Sept. 22 11 10 35

7 46 28
60 120

4)466 148

Longitude 116 37 West.

The Candidate should sign his name in full at the foot of every page.

Exn. 6.

Rotation?

Port of _____

EXAMINATION PAPER IV.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A
FIRST MATE.

To be used at the above port this _____ day of _____

N.B.—A Candidate for a First Mate's Certificate of Competency will be required to work the Questions in Papers Exn. 4 and Exn. 5, in addition to Questions in this Paper.

Space for Minor
Corrections.

10.—1877, December 25th. Mean time at Ship 3h. 46m. P.M., in latit
38° 58' N, longitude 53° 23' W. The Sun's bearing by Comp
W by S $\frac{1}{2}$ S, altitude 11° 24', height of the eye 19 feet.

Required the True Azimuth, and Error of the Compass; and supply
ing the Variation to be 24° 50' W, required the Deviation of the Comp
for that position of the Ship's head. Both by the Sun's altitude and
the Azimuth Tables.

	d.	h.	m.	s.	
M.T.S., December	25	3	46	0	P.M.
Long.	+	8	33	32	

Long. 53° 23' W
4

M.T.G. Long. .. 25 7 19 32

6,0)21,3-32

7-8

3 33-32

Var.
4-47
7-3

1841
8129

82-681

23 24 2 S
— 33

Alt. 11 24 "0
Dip. — 4 17

28 23 29 S
90 0 0

11 19 43
Corr. — 4 81

113 23 29

11 15 12
Sem. + 16 18

True alt. 11 31 30

BY ALTITUDE.

Alt. 11 31 30
Lat. 38 58 0
P.D. 113 23 29

sec. ... 0-008859
sec. ... 0-081255

2)158 52 59

79 26 29
83 57 0

cos. ... 9-263351
cos. ... 9-918830

2)19-272295

25 38 11
2

sin. ... 9-686147
097

51 16 22

489)5000(11

True az. ... S 51 16 W
Mag. az. ... S 70 19 W

439
610
439

Err. 19 3 W
Var. 24 50 W

Deviation .. 5 47 East

The Candidate should sign his name in full at the foot of every page.

PAPER IV.
EXAMINATION FOR FIRST MATES—Continued.

see for Minor
Corrections.

BY AZIMUTH TABLES.

M.T.S.	h. m. s.	Eq. T.	s.	
3 46 0 P.M.		27	1-2	
Eq. T.	— 35	8	7	
A.T.S.	3 45 25 P.M.	35	8-4	

A.T.S. 8h. 44m. P.M., lat 84° N, and dec. 23° S., give

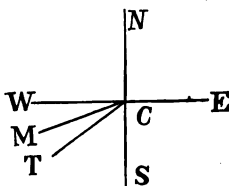
True az. N128° 48' W
180 0

True az. S 51 17 W
Mag. az. S 70 19 W

Err. 19 2 W
Var. 24 50 W

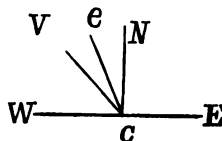
Deviation 5 48 East

Figure of, or error.



T left of M, err. W.

Figure for deviation.



e right of V, dev. E

Or, change W, var. to E, and
take difference.

Remarks.—By working to seconds of arc., the true azimuth is S 51° 15' 6" W, and the deviation 5° 46' 21 East.

- 11.—1877, August 29th, P.M., at Ship, lat. by account 42° 29' N, long. 151° 10' E. The observed altitude of the Sun's L.L. South of the observer was 56° 20' I.E. + 1' 20", height of eye 21 feet. Time by watch, August 29d. Oh. 22m. 16s., which had been found to be 1m. 2s. slow of apparent time of ship.

The difference of longitude made to the West was 18' 5 after the error on Apparent Time of Ship was determined.

Required the latitude by the Reduction to the Meridian.

T.W., Aug. ..	d. h. m. s.	D.L. ..	18-5	Long. ..	151 10 E
Slow	+ 1 2		4		4
	29 0 23 18				
D. Long. W.	— 1 14	6,0)7,4-0		6,0)60,4 40	
A.T.S., Aug.	29 0 22 4		1 14		10 4 40
Long. E.	— 10 4 40.				
A.T.G., Aug.	28 14 17 24				
	29 0 0 0				
	9 42 36				
	9 7				

T. from noon .. 22m. 4s.

The Candidate should sign his name in full at the foot of every page.

PAPER IV.

EXAMINATION FOR FIRST MATES—Continued.

Space for Minor Corrections.	$\overset{\circ}{9} \overset{'}{14} \overset{''}{59}$ N. + 8 39	Obs. alt. $\overset{\circ}{56} \overset{'}{20} \overset{''}{0}$ S I.E. + 1 20
Var.	$\overset{\circ}{9} \overset{'}{23} \overset{''}{18}$ N.	Dip. — 4 31
53°52		56 21 20
9.7		56 16 49
37464		Corr. — 0 34
48168		56 16 15
6,0)51,9-144		Sem. + 15 53
8 39.1		True alt. $\overset{\circ}{56} \overset{'}{32} \overset{''}{8}$
	m. s.	ria. 2-66572
	T. from N. 23 4	cos. 9-867747
	Lat. acc. 42 29 N.	cos. 9-994150
	Dec. 9 23 N.	const. .. 1
		<u>3-527617</u>
	True alt. $\overset{\circ}{56} \overset{'}{32} \overset{''}{8}$ S.	Nat. sin. $\overset{\circ}{3370}$ log.
	Z.D. 33 7 N.	Nat. cos. <u>837577</u>
	Dec. 9 23 N.	
	Latitude $\overset{\circ}{42} \overset{'}{30}$ North	
	<i>Remarks.</i> —By working to seconds of arc the latitude is $42^{\circ} 30' 8''$ North	

The Candidate should sign his name in full at the foot of every page.

PAPER IV.

Rotation No.

Exn. 7.

(Late E.F. 4.)

Port of _____

EXAMINATION PAPER

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A

MASTER ORDINARY.

to be used at the above Port this _____ day of _____ 18

V.B.—A Candidate for an Ordinary Master's Certificate of Competency will be required to work the Questions in Papers Exn. 4, Exn. 5, and Exn. 6, in addition to the Questions in this Paper.

see for Minor
Corrections.

12.—1877, May 7th, the observed Meridian Altitude of the Star α Orionis (Betelguese), bearing South, was $42^{\circ} 18' 10''$, height of the eye, 18 feet. Required the Latitude.

Obs. Alt.	$42^{\circ} 18' 10''$
	$\quad \quad \quad - \quad 4 \quad 11$
	$\hline 42 \quad 13 \quad 59$
Ref.	$\quad \quad \quad 1 \quad 4$
	$\hline 42 \quad 12 \quad 55$
True Alt.	$90 \quad 0 \quad 0$
	$\hline 47 \quad 47 \quad 5N$
Z.D.	$7 \quad 23 \quad 1N$
Dec.	$\hline 55 \quad 10 \quad 6 \text{ North.}$
Latitude	

The Candidate should sign his name in full at the foot of every page.

Rotation No.

Exn. 4.

Port of _____

EXAMINATION PAPER V.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A
SECOND MATE.

This Paper is to be used at the above Port this _____ day of _____ 18

Space for Minor
Corrections.

1.—Multiply 1200 by 800 by common logarithms.

1200 log 3.079181

800 log 2.908090

$$\begin{array}{r} 960000 \log 5.982271 \\ \hline \end{array}$$

Here 982271 is found exactly in Table XXIV, which gives the natural number 9600; but the index being 5, other two ciphers must be affixed to make up the 6 integers required; thus the answer is 960000.

2.—Divide 48471 by 876524 by common logarithms.

Diff. 99

1

4847 log 3.688190

+ 10

9.9

$$\begin{array}{r} 48471 \log 4.688200 \\ \hline \end{array}$$

Here the difference 99 being multiplied by 1, one figure must be cut off from the product, and the remainder, + 1 being added to the log of 4847, the sum is the log of 48471.

Diff. 50

24

8765 log 3.942752

+ 12

12.00

$$\begin{array}{r} 876524 \log 5.942764 \\ \hline \end{array}$$

Here the difference 50 being multiplied by 24, two figures must be cut off from the product.

48471 log 4.688200

876524 log 5.942764

$$\begin{array}{r} .04959 \log 8.695486 \\ \hline \end{array}$$

The Candidate should sign his name in full at the foot of every page.

EXAMINATION FOR SECOND MATES—Continued.

Space for minor
corrections.

N	
W	E
S	
S. 45° W.	
25° W. } 11	
14 E. }	
S. 34 W.	
S. 5° 38' W.	
L. 14 4	
S. 8 26 W.	
25° W. } 11 0 W.	
14 E. }	
S. 19 26 W.	
N. 45° 0' W.	
L. 16 53	
N. 28 7 W.	
25° W. } 29 0 W.	
4 E. }	
N. 57 7 W.	
S. 5° 38' E.	
L. 8 26	
S. 14 4 E.	
25° W. } 4 0 W.	
21 E. }	
S. 18 4 E.	
S. 16° 53' E.	
L. 5 38	
S. 22 31 E.	
25° W. } 1 0 W.	
24 E. }	
S. 23 31 E.	
S. 22° 30' E.	
L. 2 49	
S. 25 19 E.	
25° W. } 0 0 W.	
25 E. }	
S. 25 19 E.	
S. 22° 30' W.	
25° W. } 13 0 W.	
12 E. }	
S. 9 30 W.	
S. 11° 15' W.	
25 0 W.	
S. 13 15 E.	

3.—

Hrs.	Courses.	Knts	10ths	Winds.	Lee way.	Devia- tion.	Remarks.
1	S. ½ W.	4	6	W by S ½ S	1 ½	14° E.	A point, in Lat. 49° 54' N., Long. 6° 19' W. bear- ing by Compass N.E.
2		4	7				
3		5	4				
4		5	3				
5	N.W.	5	3	W.S.W.	1 ½	4° W	Dist. 9 miles.
6		5	5				
7		4	6				
8		3	6				
9	S. ½ E.	3	2	SW by W ½ W	¾	21° E.	(Ship's head S. ½ W, Deviation as per log.)
10		3	7				
11		4	8				
12		4	4				
1	S by E ½ E	4	5	S.W. ½ W.	½	24° E.	Variation 25° W.
2		4	6				
3		4	4				
4		4	5				
5	S.S.E.	5	2	S.W.	½	25° E.	A current } set correct S. by W. magnetic. }
6		6	4				
7		6	3				
8		6	1				
9	S.S.W.	6	4	W	0	12° E	19 miles from the time the departure was taken to the end of the day.
10		7	8				
11		3	6				
12		4	2				

Correct the Courses for Deviation, Variation, and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

Corrected Courses.	Dist.	N.	S.	E.	W.
S 34° W	9		7.5		5.0
S 19 E	20		18.9	6.5	
N 57 E	19	10.3			15.9
S 18 E	16.1		15.3	5.0	
S 24 E	18		16.4	7.3	
S 25 E	24		21.8	10.1	
S 10 W	22		21.7		8.8
S 14 E	19		18.4	4.6	
		10.3	120.0	33.5	24.7
			10.3	24.7	
			109.7	8.8	

Lat. left 49° 54' N
Diff. lat. 1 50 S

Long. left 6° 19' W
D.Long. 13 E

Lat. in 48 4 N

Long. in 6 6 W

2) 97 58

Mid. lat. 48 59

Course S 4° E. Distance 110 miles.

Remarks.—The nearest diff. lat. 109.7, and dep. 7.7 are found together in page 20, Table II; corresponding to which are the course 4° and dist. 110 miles.

Again, the diff. lat. 109.6 and dep. 9.6 are found together in page 21, corresponding to which are the course 5° and dist. 110 miles.

Hence we have the course 4½° and dist. 110.

The diff. lat. being in this instance greater than the dep. it is therefore principally used to finding the course and distance; had the dep. been the greater it would be principally used.

By logs. the diff. long. is 13.41, the course 4° 35', and the distance 110.1.

EXAMINATION FOR SECOND MATES.—Continued.

Space for Minor
Corrections.

4.—1877, September 22nd, in longitude 179°W, the observed meridian altitude of the Sun's Lower Limb was 89° 58' 10", bearing South; index error + 1' 45"; height of eye 17 feet. Required the Latitude.

	d.	h.	m.	s.		°	'
A.T.S. Sept.	22	0	0	0	Long.	179	0W.
Long. W	+	11	56	0			4
A.T.G. Sept.	22	11	56	0		6,071,6	0
		11	·	9		11	56 0

var.
58° 44'
11·9
52596
64284
6,069,5·486
11 85·4

0° 10' 39"N	Obs. Alt.	89° 58' 10"S
0 11 85S	I.E.	+ 1 45
0 0 56S	Dip	89 59 55 — 4 4
		89 55 51
	Corr.	0
	Sem.	+ 15 59
	True Alt.	90 11 50 90 0 0
	Z.D.	0 11 50S
	Dec.	0 0 56S
	Latitude	0 12 46 South.

5.—In latitude 86° 18' the departure made good was 220 miles; required the difference of longitude by parallel sailing.

Lat.	86° 18'	sec.	0·098704
Dep.	220	log.	2·842423
D. Long.	278	log.	2·486127

EXAMINATION FOR SECOND MATES.—Continued.

pace for Minor
Corrections.

6.—Required the Course and Distance from A to B, by calculation on Mercator's Principle.

Lat. of A	85° 47'N	Long.	5° 56'W
Lat. of B	20° 28'S	Long.	28° 51'W

A Lat.	85 47N	m.pts.	2802	Long.	5 56W
B Lat.	20 28S	m.pts.	1255	Long.	28 51W
	<u>56 15</u>	m.d.l.	<u>8557</u>		<u>22 55</u>
	60				60

D. Lat.	<u>8875 S</u>	D.Long.	<u>1875 W</u>
---------	---------------	---------	---------------

D.Long.	1875	log + 10	18·188808
m.d.l.	8557	log	8·551084

Course	21° 8'	tan.	<u>9·587219</u>
--------	--------	------	-----------------

Course	21° 8'	sec.	0·080288
D.L.	8875	log.	<u>8·528274</u>

Distance	8619	log.	<u>8·558512</u>
----------	------	------	-----------------

Course S21° 8W. Distance 8618 miles.

Remarks.—The latitudes being of different names, they must be added together, the sum is the diff. lat. ; the mer. parts must also be added to find the m.d. lat.

By working to seconds of arc the Course is S21° 8' 5"W, distance 8619 miles.

Form 2

Form 2

EXAMINATION PAPER A

TO BE TAKEN BY CANDIDATES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

SECTION I - 1914

I. A. H. is the name of the candidate for the degree of Doctor of Philosophy.

I. A. H. is the name of the candidate for the degree of Doctor of Philosophy. I. A. H. is the name of the candidate for the degree of Doctor of Philosophy. I. A. H. is the name of the candidate for the degree of Doctor of Philosophy.

Signature of Candidate: I. A. H. Signature of Examiner: J. H. H. Signature of Examiner: J. H. H.

Signature of Candidate	I. A. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.

These are the names of the candidates for the degree of Doctor of Philosophy.

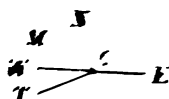
I. A. H. is the name of the candidate for the degree of Doctor of Philosophy. I. A. H. is the name of the candidate for the degree of Doctor of Philosophy. I. A. H. is the name of the candidate for the degree of Doctor of Philosophy.

Signature of Candidate	I. A. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.

Jan.

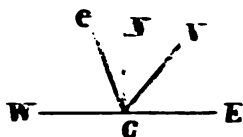
Signature of Candidate	I. A. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.
Signature of Examiner	J. H. H.	Signature of Examiner	J. H. H.

Figure for Error.



I left of M,
and W.

Figure for Deviation.



c left of V, Deviation W,
or change E. var. to W,
and add.

The Candidate should sign his name in full at the foot of every page.

EXAMINATION FOR SECOND MATES.—Continued.

Space for Minor Corrections.

To find Daily Rate.

	m. s.
Aug. 28	1 16S
Aug. 31	—
Aug. 3	—
Sept. 30	—
Oct. 12	1 17F
45	2 33
—	60
45)153(3·4	
135	
180	
180	

var.

8·29
6·4
1816
1974
21·056

Cosec.

23 25 " 0	0·087328
+	13
23 25 14	0·087341
Diff.	91
	14
	364
	91
	1274

Cos.

81 1 " 0	9·193534
—	120
81 1 9	9·193414
Diff.	1333
	9
	119,97

Sin.

68 28 0	9·966578
+	3
68 28 4	9·966581
Diff.	83
	4
	332

8.—1877, December 24th, P.M. at Ship, in latitude $36^{\circ} 4' N$, the observed altitude of the Sun's L.L. was $12^{\circ} 25' 0''$, height of eye 17 feet. Time by a Chronometer, December 24d. 6h. 30m. 16s. which was 1m. 16s. slow for mean noon at Greenwich, on Aug. 28th, and on October 12th was 1m. 17s. fast. Required the longitude by Chronometer.

	d.	h.	m.	s.	d.	
T. Chron. Dec. 24	6	30	16		Oct. 12	6
Fast	—	1	17		Oct. 31	·04
	24	6	28	59	Oct. 19	73·24
Gained	—	4	9		Nov. 30 h.	3·4
M.T.G. Dec.	24	6	24	50	Dec. 24 6	29296
			6·4		73 6	21972
						6,0)24,9·016
						4 9

Dec.

	m.	s.	s.
23 25 35S	— 0	2·52	1·245
— 21	+	7·97	6·4
23 25 14S	+	5·45	4980
90 0 0			7470
P.D. 113 25 14			7·9680

Obs. Alt.	12 25 " 0	Alt.	12 33 " 5	
Dip	— 4 4	Lat.	36 4 0	sec. 0·092410
		P.D.	113 25 14	cosec. 0·087341
	12 20 56			
Correction	— 4 9	2)162 2 19		
	12 16 47	81 1 9	cos.	9·193414
Sem.	+ 16 18	68 28 4	sin.	9·968581
True Alt.	12 33 5			
		H.A.	3 30 5	log 9·291746
		Eq. T.	+	5
				07

M.T.S. Dec.	24	3	30	10	
M.T.G. Dec.	24	6	24	50	7 = 1s.

	2 54 40
	60 120
4)174 160	
Longitude	43 40 West.

The Candidate should sign his name in full at the foot of every page.

Exn. 6.
Late E. F. 8.)

Rotation No.

EXAMINATION PAPER V.

TO BE USED BY A STUDENT FOR A CERTIFICATE OF COMPETENCY AS

FIRST MATE.

To be used at the above School this _____ day of _____ 18

Space for Minor
Corrections.

1.—1877, June 15th. Mean time at Ship 8h. 55m. A.M., in latitude $43^{\circ} 3' S$, longitude $142^{\circ} 35' E$. The Sun's bearing by Compass NE $\frac{1}{4}$ E, altitude $11^{\circ} 2' 10''$, I.E. + $0' 15''$. Height of the eye 22 feet.

Required the True Azimuth and Error of the Compass; and supposing the variation to be $11^{\circ} 10' E$. Required the Deviation of the Compass for that position of the Ship's head; both from the Altitude and from the Time Azimuth Tables.

	d.	h.	m.	s.	
Civil M.T.S., June	15	8	55	0	A.M. Long. $142^{\circ} 35' E$
	—	1	12		4

Astron. M.T.S., June ..	14	20	55	0	6,0)57,0 20
Longitude E	—	9	30	20	9 30 20

M.T.G., June	14	11	24	40	
--------------------	----	----	----	----	--

Var.

11 4

Dec.

$23^{\circ} 17' 46'' N$
+ 1 20

Obs. alt.	$11^{\circ} 2' 10''$
I.E.	+ 0 15

$23^{\circ} 19' 6'' N$
90 0 0

Dip.	11 2 25
	— 4 37

,0)8,0484

P.D. 113 19 6

	10 57 48
Corr.	— 4 40

1 204

	10 53 8
Sem.	+ 15 47

True alt.	11 8 55
----------------	---------

BY SUN'S ALTITUDE.

Alt.	$11^{\circ} 8' 55''$
Lat.	$43^{\circ} 3' 0''$
P.D.	113 19 6

sec.	0-006276
sec.	0-136226

2)167 31 1

83 45 30
29 33 36

cos.	9-085741
cos.	9-939410

2)19-119653

21 16 50
2

sin.	9-559826
	558

N 42 33 40 E

541)26800(49
2164

Or N 42 34 E True az.

N 47 49 E Mag. az.

5160
4869

5 15 W	Error
11 10 E	Var.

291

16 25 Deviation

PAPER V.

EXAMINATION FOR FIRST MATES—Continued.

as for Minor
corrections.

BY AZIMUTH TABLES.

M.T.S.	h. m. s. 8 55 0 A.M.	Eq. T.	— 3	Var.	5
	+ 2		+ 5		11
A.T.S.	8 55 2 A.M.		+ 2		5.5

A.T.S., 8h. 56m. A.M., lat. 43 S, and
dec. 23° S, giveTrue az. S 137° 28' E
180 0

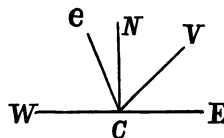
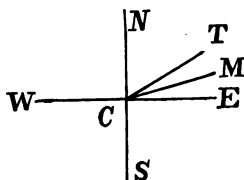
True az. N 42 32 E

Mag. az. N 47 49 E

Error 5 17 W

Var. 11 10 E

Deviation 16 27 West



2.—1877, September 22nd, P.M. at Ship. Lat. by account 43° 18' N, long. 172° W. The observed altitude of the Sun's L.L. South of the observer was 46° 17', height of eye 15 feet. Time by watch, September 22d. Oh. 42m. 16s., which had been found to be 24m. 18s. fast of apparent Time at Ship.

The difference of longitude made to the East was 27'·5 after the error on Apparent Time at Ship was determined.

Required the Latitude by the Reduction to the Meridian.

A.T.W., Sept.	d. h. m. s. 22 0 42 16	D. Long. 27'·5 E	Long. 172 0 W
Fast	— 24 18	4	4

D. Long.	+ 22 0 17 58	6,0)11,0-0	6,0)68,8 0
	+ 1 50	1 50	11 28 0

A.T.S., Sept.	22 0 19 48
Long. W. ..	+ 11 28 0

T. from noon 19m. 48s.

A.T.G., Sept.	22 11 47 48
	11·8

Var.

Dec.

58·44

0° 10' 39' N

Obs. alt. 46° 17' 0" S

11·8

0 11 30 S

Dip. — 3 49 S

46752

0 0 51 S

Corr. — 0 50

64284

46 13 11

6,0)68,9·592

Sem. + 15 59

11 29·5

True alt. 46 26 20

The Candidate should sign his name in full at the foot of every page.

PAPER V.

EXAMINATION FOR FIRST MATES—Continued.

Space for Minor Corrections.		T. from N. 19 28	rising 2-57199
		Lat. acc. 43 18 N	cos. 9-861996
		Dec. 0 1 S	cos. 10-000000
			constan. .. 1-
Rising.			
h. m.			2716
19 45	2-56947	True alt. 46 28 S	Nat. sin. 724974
3	+ 252		
19 48	2-57199	M.Z.D. 43 18 N	Nat. cos. 727690
		Dec. 0 1 S	
		Latitude 43 17 North	
<i>Remarks.</i>—The declination is marked N on the 22nd of September S on the 23rd. Mark the dec. N and the correction S, take their difference mark it S, the name of the greater. By working to seconds of arc, the l 43° 17' 14" N. 1877, December 8th. The observed Meridian Altitude of the Star α 1 (Vega) bearing North, was 21° 18' 50" N. Height of the eye 17 Required the Latitude.			
		Obs. alt. 21 18 50 N	
		Dip. — 4 4 Table V.	
		21 14 46	
		Ref. — 2 28 Table IV.	
		True alt. 21 12 18	
		90 0 0	
		Zen. dist. 68 47 42 S	
		Dec. 88 40 15 N. Page 359 N.A.	
		Latitude 30 7 27 South	

The Candidate should sign his name in full at the foot of every page.

Rotation No.

Exn. 4.

Port of _____

EXAMINATION PAPER VI.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A
SECOND MATE.

This Paper to be used at the above Port this _____ day of _____ 18 _____

see for Minor
Corrections.

Diff. 80
4
—
32,0
—

Diff. 153
6
—
91,8
—

1.—Multiply 54.274 by 284.56 by common logarithms.

54.27	log	1.784560
		82
54.274	log	1.784592
284.5	log	2.454082
		92
284.56	log	2.454174
54.274	log	1.784592
284.56	log	2.454174
15444.28	log	4.188766
		647
		281)1190.000(4.284
		1124
		660
		562
		980
		848
		1870
		1124

2.—Divide .0648 by .000721.

	By Common Indices.	By Negative Indices.
.0648	log 8.808211	2.808211
.000721	log 6.857985	4.857985
89.18	log 1.950276	1.950276
	67	67
	49)90(1	49)90(1
	49	49

The Candidate should sign his name in full at the foot of every page.

Space for Minor
corrections.

N	
W	E
S	
N. 67° 30' E	
25° W	11 0 W
14 E	
N. 56 30 E	
N. 84° 23' E	
25 W	11 0 W
14 E	
N. 73 23 E	
S. 84 23 E	
L. 5 38	
25 W	78 45 E
4 E	21 0 W
S. 99 45 E	
180 0	
N. 80 15 E	
S. 67° 30' E	
L. 8 26	
S. 59 4 E	
25 W	27 0 W
2 W	
S. 86 4 E	
S. 33° 45' E	
L. 11 15	
S. 22 30 E	
25 W	37 0 W
12 W	
59 30 E	
N. 22° 30' E	
L. 14 4	
N. 8 26 E	
25 W	19 0 W
6 E	
N. 10 34 W	
N. 39° 23' E	
L. 5 38	
25 W	33 45 E
12 E	13 0 W
N. 20 45 E	
S. 22 30' E	
V. 25 0 W	
S. 47 30 E	

SUPPLEMENT TO NAVIGATION.

PAPER VI.

EXAMINATION FOR SECOND MATES—Continued.

3.—

Hrs.	Courses.	Knts.	10ths	Winds.	Lee-way.	Dev.	Remarks:
1	E $\frac{1}{2}$ N	5	6	S	0	14°E	A point, in Lat. 54° 29' N Long. 0° 35' W
2		4	4				
3		4	3				
4		4	7				
5	E $\frac{1}{2}$ S	4	7	NE by N $\frac{1}{2}$ N	$\frac{1}{2}$	4°E	bearing by Compass W S W.
6		4	3				
7		4	4				
8		4	6				
9	ESE	4	4	NE	$\frac{3}{4}$	2°W	(Ship's Head E $\frac{1}{2}$ N Deviation as per log) Dist. 6 miles.
10		5	0				
11		5	0				
12		5	6				
1	SE by S	4	5	E by N	1	12°W	Variation 25° W
2		3	5				
3		3	5				
4		3	5				
5	NNE	3	6	E	1 $\frac{1}{2}$	6°E	A current set Correct Mag- } SSE netic.
6		4	4				
7		3	7				
8		4	3				
9	NE $\frac{1}{2}$ N	4	7	E by S $\frac{1}{2}$ S	$\frac{1}{2}$	12°E	12 miles from the time of departure was taken to the end of the day.
10		5	3				
11		5	4				
12		5	6				

Correct the Courses for Deviation, Variation and Leeway, and find the Course and Distance from the given Point, and the Latitude and Longitude in, by Inspection.

Corrected Courses.	Dist.	N.	S.	E.	W.
N 57° E	6	3.3		5.0	
N 73 E	19	5.6		18.2	
N 80 E	18	8.1		17.7	
S 86 E	20		1.4	20.0	
S 60 E	15		7.5	13.0	
N 11 W	16	15.7			
N 21 E	21	19.6		7.5	
S 48 E	12		8.0	8.9	
		47.3	16.9	90.3	3-1
		16.9		8.1	
		80.4	Dep.	87.2	

Lat. left 54° 29' N
D. lat. 30 N

Long. left 0° 35' W
D. long. 2 31 E

Lat. in 54 59 N

Long. in 1 56 E

2)109 28

Mid. lat. 54 44

EXAMINATION FOR SECOND MATES.—Continued.

Mid. lat. 54° and dep., $87'$ in lat. col., give dist. $148=2^{\circ} 28'$ diff. Long.
 55 87.2 152=2 32

The nearest dep. 87 in Table II. and nearest diff. lat. 80 are found together in page 35, and they give 71° at the bottom of the Table and 92 in the dist. column; hence we have course N 71° E, dist. 92 miles.

Remarks.—The mid. lat. is nearly $54\frac{1}{2}^{\circ}$; hence to find the diff. long. proceed as above to find the diff. long. due to mid lat. 54° and nearest dep. 87, and then that due to mid. lat. 55° add dep. 87.2 , take the difference between the results, and divide it by 4, multiply the quotient by 3 and add the product to the diff. long. due to mid. lat. 54° .

By logs. the diff. long is $2^{\circ} 31'$, Course $70^{\circ} 47'$, and distance 92.36 miles.

Space for Minor
Corrections.

4.—1877, September 23rd, in longitude $85^{\circ} 0' E$, the observed meridian altitude of the Sun's Lower Limb was $89^{\circ} 59' 20''$, bearing North, index error 0', height of eye 21 feet; required the latitude.

	d.	h.	m.	s.		Long.	85°	$0'$	E
A.T.S. Sept.	28	0	0	0					
Long. E	—	5	40	0					4
A.T.G. Sept.	22	18	20	0		6,0	34,0	0	
		5.7					5	40	0
var.	Dec.								
58.48	0	12	45	S	Obs. Alt.	89	59	20	N
5.7	0	5	38	N	Dip.	—	4	31	
40936							89	54	49
29240	0	7	12	S	Correction			0	
6,0)33,3-336					Sem.		+	15	59
5 33.3					True Alt.	90	10	48	
						90	0	0	
					Z. D.	0	10	48	N
					Dec.	0	7	12	S
					Latitude	0	3	36	North.

5.—In latitude $86^{\circ} 12'$ the departure made good was 94 miles.
 Required the difference of Longitude by parallel sailing.

Lat.	$86^{\circ} 12'$	sec.	1.178657
Dep.	94	log	1.978128
D.Long.	1418	log	3.151785

The Candidate should sign his name in full at the foot of every page.

N

EXAMINATION FOR SECOND MATES.—Continued.

Space for Minor
Corrections.6.—Required the Course and Distance from A to B, by
calculation on Mercator's Principle.

Lat. of A	18° 48' N	Long.	166° 55' E
Lat. of B	16° 11' S	Long.	151° 48' W
A Lat.	18° 48' N	m. pts.	886
B Lat.	16° 11' S	m. pts.	984
	29 59	m.d.lat.	1820
	60		318 48
			360 0
D. Lat.	1799 S		41 17
			60
		D. Long.	2477E
D. Long.	2477	log + 10	18.898926
	1820	log	8.260071
Course	53° 42'	tan.	10.188855
Course	53° 42'	sec.	0.227669
Diff. Lat.	1799	log.	8.255031
Distance	8089	log	8.482700

Course S58° 42'E, Distance 8089 miles.

Remarks.—By working to seconds of arc, the Course is S58° 41' 35"E, and Distance 8089 miles.

The Latitudes are of different names, therefore they must be added to find the D. Lat., also the mer. parts must be added to find the m. d. lat

The Longitudes are also of different names, and they must be added to find the Diff. Long. The sum is above 180°, it must therefore be taken from 360° to find the Diff. Long.

The Candidate should sign his name in full at the foot of every page.

Exn. 5.

Rotation No.

Port of _____

EXAMINATION PAPER VI.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A

SECOND MATE.

To be used at the above Port this _____ day of _____ 18

N.B.—A Candidate for a Second Mate's Certificate of Competency will be required to work the Questions in Paper Exn. 4, in addition to the Questions in this Paper.

pace for Minor
Corrections.

7.—1880, December 8th, find the time of High Water at Coleraine, A.M. and P.M.

	d. h. m.	d. h. m.
Standard, Londonderry, Dec. 8	0 59 P.M.	9 1 37 A.M.
Constant, Coleraine	— 1 37	— 1 37
High Water, Coleraine	<u>8 11 22 A.M.</u>	<u>9 0 0 Midnight.</u>
		8 0 22 A.M.
		— 1 37
		<u>7 10 45 P.M.</u>

8.—1877, June 14th, at 10h. 22m. P.M. Apparent Time at Ship, in lat. $66^{\circ} 39' N$, long. $170^{\circ} W$, the Sun's Magnetic Amplitude was $N 2^{\circ} E$. Required the True Amplitude, and Error of the Compass; and supposing the Variation to be $25^{\circ} 12' E$, required the Deviation of the Compass for that position of the Ship's Head.

	d. h. m. s.	
A.T.S. June 14	10 22 0 P.M.	Long. $170^{\circ} 0' W$.
Long. W	+ 11 20 0	4
A.T.G. June 14	21 42 0	6,0)68,0 0
	15 0 0 0	<u>11 20 0</u>
	<u>2 18</u>	
	<u>2.8</u>	

The Candidate should sign his name in full at the foot of every page.

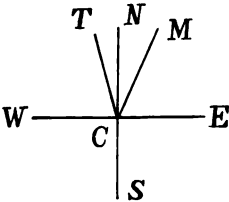
PAPER VI.

EXAMINATION FOR SECOND MATES—Continued.

Space for Minor Corrections.
var.
6-08
2-8
1809
1206
13-869

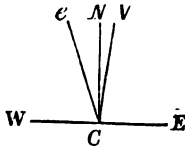
Dec.				
23 20 24N	Lat.	68 39N	sec.	0-401925
— 14	Dec.	23 20N	sin.	9-597783
23 20 10N	True Amp.	W87 54N	sin.	9-999708
		180 0		
	or, True Amp.	E 92 6N		
	Mag. Amp.	E 81 34N		
	Error	10 32W		
	Variation	25 12E		
	Deviation	35 44 West.		

Figure for Error.



T left of M,
Error W.

Figure for Deviation



e left of W,
Deviation W, or chang
E Var. to W and add.

See pages 114, 373, 374, and 375 Bergen's Navigation, for the use of the Algebraic Signs in this Question.

Remarks.—Take the True Amplitude from 180° to bring it to the same name as the Magnetic Amplitude.

By working to seconds of arc the Deviation is 35° 33'E; thus there is a difference of 11' between working to minutes and to seconds, in this instance. This shows that care must be taken in Observations for Amplitudes in high latitudes.

By working from the A.M. tide at Londonderry on the 8th of December, the time of the corresponding tide at Coleraine is found to be on P.M. of the 7th; in this case take next, that is the P.M. tide at Londonderry, and work from it.

PAPER VI. EXAMINATION FOR SECOND MATES—Continued.

Space for Minor Corrections.	
To find Daily Rate.	
d.	m. s.
Mar. 24	86 20F
Mar. 31	—
Mar. 7	—
Apl. 3	86 43F
10	)28
Gaining	2.3
var.	
	7.06
	11.4
	2824
	7766
	6,0)8,0.484
	1.20.4
Cosec.	
23 19 0	0.037001
	+
113 19 6	0.037006
Diff. 91	6
	5,46
Cos.	
83 45 0	9.036896
	— 578
83 45 30	9.036318
Diff.	1925
	30
	577,50
sin.	
72 86 0	9.979658
	+
72 36 30	9.979681
Diff.	66
	35
	330
	198
	23,10

3.—1877, June 15th, A.M. at Ship in latitude $43^{\circ} 3' S$, the observed altitude of the Sun's Lower Limb was $11^{\circ} 2' 10''$. I.E. + $0' 15''$, height of eye 23 feet. Time by a Chronometer, June 14d. 12h. 4m. 2s., which was 36m. 20s. fast for mean noon at Greenwich, March 24th, and on April 3rd was 36m. 43s. fast. Required the longitude by Chronometer.

	d.	h.	m.	s.	d.	
T. Chron. June	14	12	4	2	April 3	11
Fast	—	—	36	43	April 30	.04
	14	11	27	19	April 27	72.24
Gained	—	—	2	47	May 31 h.	2.3
	14	11	24	32	June 14 11	21732
M.T.G. June	14	11	24	32	72 11	14488
	11.4					6,0)16,6.612
						2.46.6
Dec.					Eq. T.	Var.
23 17 46N					m. s.	s.
+ 1 20					— 0 0.58	0.529
					+ 6.03	11.4
23 19 6N					+ 0 5.45	2116
90 0 0						5819
P.D. 113 19 6						6.0308
Obs. Alt.	11	2	10		Alt. 11 8 55	
I. E.	+	0	15		Lat. 43 3 0	sec. 0.136226
	11	2	25		P.D. 113 19 6	cosec. 0.037006
Dip	—	4	37		2)167 81 1	
	10	57	48		83 45 30	cos. 9.036318
Correction	—	4	40		72 36 35	sin. 9.979681
	10	53	8			
Semi.	+	15	47		h. m. s.	
	11	8	55		H.A. 20 54 46	log 9.189231
True Alt.					Eq. T. + 5	39
	M.T.S. June 14	20	54	51		16=2s.
	M.T.G. June 14	11	24	32		
					9 30 19	
					60 120	
					4)570 139 180	
					Longitude 142° 34' 45" East.	

Remarks.—The Eq. T. on June 14th, on page 11 of the month is 0 m. 0.58s.; and by the precept on page I of the month, it has to be subtracted from App. T., but on the 15th it has to be added; mark the equation — and the correction +, take their difference and mark it +, the same as the sign of the greater.

The Candidate should sign his name in full at the foot of every page.

Exn. 6

Port of _____

Rotation No.

EXAMINATION PAPER VI.

TO BE USED BY A CANDIDATE FOR A CERTIFICATE OF COMPETENCY AS A

FIRST MATE.

To be used at the above Port this _____ day of _____ 18

N.B.—A Candidate for a First Mate's Certificate of Competency will be required to work the Questions in Papers Exn. 4, and Exn. 5, in addition to the Questions in this Paper.

Space for Minor Corrections.

10.—1877, December 24th. Mean time at Ship 8h. 30m. P.M., in latitude $36^{\circ} 4' N$, longitude $43^{\circ} 40' W$. The Sun's bearing by Compass $SW \frac{1}{4} W$, altitude $12^{\circ} 25'$. Height of the eye 17 feet.

Required the True Azimuth, and Error of the Compass; and supposing the Variation to be $24^{\circ} 30' W$, required the Deviation of the Compass for that position of the Ship's head. Both from the Altitude, and by the Time Azimuth Tables.

	d.	h.	m.	s.		
M.T.S. Dec.	24	3	30	0	P.M.	Long. $43^{\circ} 40' W$.
Long. W	+	2	54	40		4

M.T.G. Dec.	24	6	24	40		6,0)17,4 40
					6.4	2 54 40

Var.

Dec.

8.29
6.4

$23^{\circ} 25' 35''$
— 21

Obs. alt. $12^{\circ} 25' 0''$
Dip. — 4 4

1816
1974

$23^{\circ} 25' 14''$
 $90^{\circ} 0' 0''$

Corr. — 4 9

21.056

P.D. $118^{\circ} 25' 14''$

Sem. $12^{\circ} 16' 47''$
+ 16 18

True alt. $12^{\circ} 33' 5''$

Alt. $12^{\circ} 33' 5''$
Lat. $36^{\circ} 4' 0''$
P.D. $118^{\circ} 25' 14''$

sec. 0.010503
sec. 0.092410

2)162 2 19

81 1 9
82 24 5

cos. 9.193534
cos. 9.926511

2)19.222958

24 7 39
2

sin. 9.611479
294

True az. S $48^{\circ} 15' 18''$ W

470)18500(39
1410

Or S $48^{\circ} 15'$ WMag. az. S $53^{\circ} 26'$ W

4400
4230

Err. $5^{\circ} 11'$ WVar. $24^{\circ} 30'$ WDeviation $19^{\circ} 19'$ East

PAPER VI. EXAMINATION FOR FIRST MATES—Continued.

Space for Minor
Corrections.

M.T.S.	<u>h. m. s.</u> 3 30 0	Eq. +	<u>s.</u> 2	<u>s.</u> 1 2
	— 5		— 7	6
A.T.S.	<u>3 29 55</u>		<u>— 5</u>	<u>7 2</u>

Lat. 36° N Dec. 23° S, and

A.T.S.	<u>h. m.</u> 3 28	Give True az. N	<u>131 50 W</u>
	3 32		131 7
	<u>2) 7 0</u>		<u>2) 262 57</u>
	<u>3 30</u>	True az. N	<u>131 23 W</u>
			180 0
		Or True az. ... S	<u>48 32 W</u>
		Mag. az. S	<u>53 26 W</u>
		Err.	<u>4 54 W</u>
		Var.	<u>24 30 W</u>
		Deviation	<u>19 36 East</u>

11.—1877, December 21st A.M. at Ship, lat. by account 56° 41' S, long. 49° 12' W. The observed altitude of the Sun's L.L. North of the observer was 56° 14', I.E. — 2' 15", height of eye 24 feet. Time by watch, December 21d. 23h. 36m. 18s., which had been found to be 2m. 19s. fast of apparent time at ship.

The difference of Longitude made to the W was 21.5 after the error on Apparent Time at Ship was determined.

Required the latitude by the Reduction to the Meridian.

T.W., Dec.,	<u>a. h. m. s.</u> 21 23 36 18	D. Long. 21.5 W	Long. <u>49 12 W</u>
Fast	— 2 19	4	4
	<u>21 23 33 59</u>	<u>6,0) 8,6 0</u>	<u>6,0) 19,6 48</u>
D. Long. W	— 1 26	<u>1 26</u>	<u>3 16 48</u>
A.T.S., Dec. 21	<u>23 32 33</u>		
Long. W	+ 3 16 48	<u>h. m. s.</u> 24 0 0	
A.T.G., Dec. 22	<u>2 49 11</u>	<u>23 32 33</u>	
	<u>2 8</u>	T. from N	<u>27 27</u>

Var.

0.93

2.8

744

186

2.604

Obs. alt. 56 14 0 N
I.E. — 2 15

Dip. 56 11 45
— 4 49

Corr. 56 6 56
— 0 34

Sem. 56 6 22
+ 16 18

True alt. 56 22 40

The Candidate should sign his name in full at the foot of every page.

PAPER VI.

EXAMINATION FOR FIRST MATES—Continued.

Space for Minor
Corrections.

Rising.		
27° 25'	2	2-85413
		106
27 27		2-85518

	m. s.	
T. from N	 27 27	rising 2-85518
Lat. acc.	 56 41	cos. 9-739783
Dec.	 23 27	cos. 9-962562
		constant .. 1-

True alt.	 56 23 N	Nat. sin.	832760	8610 log.	3-557525
M.Z.D.	 33 14 S	Nat. cos.	886370		
Dec.	 23 27 S				
Latitude	 56 41 South				

Remarks.—By working to seconds of arc, the latitude is $56^{\circ} 42' 2''$ S.

1877, June 12th. The observed Meridian Altitude of the Star
a Scorpii (Antares) bearing South was $20^{\circ} 17' 10''$.
Height of the eye 23 feet.

Required the Latitude.

Obs. alt.	.....	20 17 10 S
Dip.	.....	— 4 48 Table V.

		20 12 27
Ref.	.....	— 2 85 Table IV.

True alt.	.....	20 9 52
		90 0 0

Zen. dist.	.....	69 50 8 N
Dec.	.....	26 9 41 S. Page 354 N.A.

Latitude		48 40 27 North
----------	-------	----------------

The Candidate should sign his name in full at the foot of every page.

THE FOLLOWING
TABLES
ARE EXTRACTED FROM
BERGEN'S EPITOME
OF
NAVIGATION.

TABLE IV.

MEAN ASTRONOMICAL REFRACTION.

Subtract the Ref.

App. Alt.	Ref.	Diff. to 1'	App. Alt.	Ref.	App. Alt.	Ref.	App. Alt.	Ref.	App. Alt.	Ref.	App. Alt.	Ref.
0 0	34 54	12.5	6 1	8 22	7 1	7 19	8 32	6 7	10 32	5 1	12 32	4 14
0 10	32 49	11.7	6 2	8 21	7 2	7 18	8 34	6 5	10 34	5 0	12 34	4 13
0 20	30 52	10.9	6 3	8 19	7 3	7 17	8 36	6 4	10 36	4 59	12 36	4 13
0 30	29 3	10.1	6 4	8 18	7 4	7 16	8 38	6 3	10 38	4 58	12 38	4 12
0 40	27 23	9.3	6 5	8 17	7 5	7 15	8 40	6 2	10 40	4 57	12 40	4 11
0 50	25 50	8.6	6 6	8 16	7 6	7 14	8 42	6 0	10 42	4 56	12 42	4 11
1 0	24 25	7.8	6 7	8 15	7 7	7 13	8 44	5 59	10 44	4 55	12 44	4 10
1 10	23 7	7.1	6 8	8 14	7 8	7 12	8 46	5 57	10 46	4 54	12 46	4 9
1 20	21 56	6.5	6 9	8 13	7 9	7 11	8 48	5 56	10 48	4 53	12 48	4 9
1 30	20 51	5.9	6 10	8 12	7 10	7 10	8 50	5 55	10 50	4 53	12 50	4 8
1 40	19 52	5.4	6 11	8 11	7 11	7 9	8 52	5 54	10 52	4 52	12 52	4 7
1 50	18 58	4.9	6 12	8 10	7 12	7 8	8 54	5 52	10 54	4 50	12 54	4 7
2 0	18 9	4.6	6 13	8 9	7 13	7 7	8 56	5 51	10 56	4 50	12 56	4 6
2 10	17 23	4.2	6 14	8 8	7 14	7 7	8 58	5 50	10 58	4 49	12 58	4 5
2 15	17 2	4.2	6 15	8 6	7 15	7 6	8 60	5 49	10 60	4 48	12 60	4 5
2 20	16 41	4.0	6 16	8 5	7 16	7 5	9 2	5 47	11 2	4 47	13 2	4 4
2 25	16 21	4.0	6 17	8 4	7 17	7 4	9 4	5 46	11 4	4 46	13 4	4 3
2 30	16 1	3.8	6 18	8 3	7 18	7 4	9 6	5 45	11 6	4 45	13 6	4 3
2 35	15 42	3.8	6 19	8 2	7 19	7 3	9 8	5 44	11 8	4 44	13 8	4 2
2 40	15 23	3.6	6 20	8 0	7 20	7 2	9 10	5 43	11 10	4 44	13 10	4 2
2 45	15 5	3.4	6 21	7 59	7 21	7 1	9 12	5 42	11 12	4 43	13 12	4 1
2 50	14 48	3.4	6 22	7 58	7 22	7 1	9 14	5 41	11 14	4 42	13 14	4 1
2 55	14 31	3.2	6 23	7 57	7 23	7 0	9 16	5 40	11 16	4 41	13 16	4 0
3 0	14 15	3.2	6 24	7 56	7 24	6 59	9 18	5 39	11 18	4 40	13 18	4 0
3 5	13 59	3.0	6 25	7 55	7 25	6 58	9 20	5 38	11 20	4 40	13 20	3 59
3 10	13 44	3.0	6 26	7 53	7 26	6 57	9 22	5 36	11 22	4 39	13 22	3 58
3 15	13 29	2.8	6 27	7 52	7 27	6 56	9 24	5 35	11 24	4 38	13 24	3 58
3 20	13 15	2.8	6 28	7 51	7 28	6 55	9 26	5 34	11 26	4 37	13 26	3 57
3 25	13 1	2.6	6 29	7 50	7 29	6 54	9 28	5 33	11 28	4 36	13 28	3 56
3 30	12 48	2.4	6 30	7 49	7 30	6 53	9 30	5 32	11 30	4 36	13 30	3 56
3 35	12 36	2.4	6 31	7 48	7 32	6 51	9 32	5 31	11 32	4 35	13 32	3 55
3 40	12 24	2.4	6 32	7 47	7 34	6 50	9 34	5 30	11 34	4 34	13 34	3 55
3 45	12 12	2.4	6 33	7 46	7 36	6 48	9 36	5 29	11 36	4 33	13 36	3 54
3 50	12 1	2.2	6 34	7 45	7 38	6 47	9 38	5 28	11 38	4 33	13 38	3 54
3 55	11 50	2.2	6 35	7 44	7 40	6 45	9 40	5 27	11 40	4 32	13 40	3 53
4 0	11 39	2.2	6 36	7 43	7 42	6 44	9 42	5 26	11 42	4 31	13 42	3 52
4 5	11 29	2.0	6 37	7 42	7 44	6 43	9 44	5 25	11 44	4 31	13 44	3 52
4 10	11 18	2.0	6 38	7 41	7 46	6 41	9 46	5 23	11 46	4 30	13 46	3 51
4 15	11 8	1.8	6 39	7 40	7 48	6 39	9 48	5 22	11 48	4 29	13 48	3 51
4 20	10 59	1.8	6 40	7 39	7 50	6 37	9 50	5 21	11 50	4 29	13 50	3 50
4 25	10 50	2.0	6 41	7 38	7 52	6 36	9 52	5 20	11 52	4 28	13 52	3 49
4 30	10 40	1.8	6 42	7 37	7 54	6 34	9 54	5 19	11 54	4 27	13 54	3 49
4 35	10 31	2.0	6 43	7 36	7 56	6 33	9 56	5 18	11 56	4 26	13 56	3 48
4 40	10 21	1.8	6 44	7 35	7 58	6 31	9 58	5 17	11 58	4 25	13 58	3 48
4 45	10 12	1.8	6 45	7 34	7 60	6 29	9 60	5 16	11 60	4 25	13 60	3 47
4 50	10 3	1.6	6 46	7 33	8 2	6 28	10 2	5 15	12 2	4 24	14 2	3 47
4 55	9 55	1.8	6 47	7 32	8 4	6 26	10 4	5 14	12 4	4 23	14 4	3 46
5 0	9 46	1.6	6 48	7 31	8 6	6 25	10 6	5 13	12 6	4 23	14 6	3 46
5 5	9 38	1.4	6 49	7 30	8 8	6 23	10 8	5 12	12 8	4 22	14 8	3 45
5 10	9 31	1.4	6 50	7 29	8 10	6 22	10 10	5 11	12 10	4 21	14 10	3 45
5 15	9 24	1.6	6 51	7 28	8 12	6 20	10 12	5 10	12 12	4 21	14 12	3 44
5 20	9 16	1.4	6 52	7 27	8 14	6 19	10 14	5 9	12 14	4 20	14 14	3 43
5 25	9 9	1.4	6 53	7 26	8 16	6 17	10 16	5 8	12 16	4 19	14 16	3 43
5 30	9 2	1.4	6 54	7 25	8 18	6 16	10 18	5 7	12 18	4 19	14 18	3 42
5 35	8 55	1.4	6 55	7 24	8 20	6 15	10 20	5 6	12 20	4 18	14 20	3 42
5 40	8 48	1.2	6 56	7 23	8 22	6 13	10 22	5 5	12 22	4 17	14 22	3 41
5 45	8 42	1.2	6 57	7 22	8 24	6 12	10 24	5 4	12 24	4 17	14 24	3 41
5 50	8 36	1.2	6 58	7 21	8 26	6 11	10 26	5 3	12 26	4 16	14 26	3 40
5 55	8 30	1.2	6 59	7 20	8 28	6 10	10 28	5 2	12 28	4 15	14 28	3 40
6 0	8 23	1.4	7 0	7 20	8 30	6 9	10 30	5 2	12 30	4 15	14 30	3 39

TABLE IV.

MEAN ASTRONOMICAL
REFRACTION.

App. Alt.	Ref.	App. Alt.	Ref.	App. Alt.	Ref.
14 30	3 39	20 30	2 33	34 01	25
14 36	3 37	20 36	2 32	34 30	1 24
14 42	3 36	20 42	2 31	35 01	1 22
14 48	3 35	20 48	2 31	35 30	1 21
14 54	3 34	20 54	2 30	36 01	1 19
15 03	3 32	21 02	2 29	36 30	1 18
15 06	3 31	21 12	2 28	37 01	1 16
15 12	3 29	21 24	2 26	37 30	1 15
15 18	3 28	21 36	2 25	38 01	1 14
15 24	3 26	21 48	2 24	38 30	1 13
15 30	3 25	22 02	2 22	39 01	1 11
15 36	3 23	22 12	2 21	39 30	1 10
15 42	3 22	22 24	2 19	40 01	1 8
15 48	3 21	22 36	2 18	40 30	1 7
15 54	3 20	22 48	2 16	41 01	1 6
16 03	3 19	23 02	2 15	41 30	1 5
16 06	3 18	23 12	2 14	42 01	1 4
16 12	3 17	23 24	2 13	42 30	1 3
16 18	3 16	23 36	2 11	43 01	1 2
16 24	3 14	23 48	2 10	43 30	1 1
16 30	3 13	24 02	2 9	44 01	1 0
16 36	3 12	24 12	2 8	44 30	0 59
16 42	3 10	24 24	2 7	45 00	0 58
16 48	3 9	24 36	2 5	45 30	0 57
16 54	3 8	24 48	2 4	46 00	0 56
17 03	7	25 02	3	46 30	0 55
17 06	6	25 12	2	47 00	0 54
17 12	5	25 24	1	47 30	0 53
17 18	3	25 36	0	48 00	0 52
17 24	2	25 48	1 59	48 30	0 51
17 30	1	26 01	58	49 00	0 50
17 36	0	26 12	57	49 30	0 49
17 42	59	26 24	56	50 00	0 48
17 48	58	26 36	55	50 30	0 47
17 54	57	26 48	54	51 00	0 47
18 02	56	27 01	53	52 00	0 45
18 06	55	27 12	52	53 00	0 44
18 12	54	27 24	51	54 00	0 42
18 18	53	27 36	50	55 00	0 40
18 24	52	27 48	49	56 00	0 39
18 30	51	28 01	48	57 00	0 38
18 36	50	28 12	47	58 00	0 36
18 42	49	28 24	46	59 00	0 35
18 48	48	28 36	45	60 00	0 33
18 54	47	28 48	44	61 00	0 32
19 02	46	29 01	44	63 00	0 29
19 06	45	29 12	43	65 00	0 27
19 12	44	29 24	42	67 00	0 25
19 18	43	29 36	41	69 00	0 22
19 24	42	29 48	40	71 00	0 20
19 30	41	30 01	40	73 00	0 18
19 36	40	30 20	39	75 00	0 16
19 42	39	30 40	38	77 00	0 14
19 48	38	31 01	36	79 00	0 11
19 54	37	31 20	35	81 00	0 9
20 02	37	31 40	34	83 00	0 7
20 06	36	32 01	32	85 00	0 5
20 12	35	32 30	31	87 00	0 3
20 18	34	33 01	29	89 00	0 1
20 24	34	33 30	27	90 00	0 0

TABLE V.

Dip of the Sea Horizon.

Height of the Eye in Feet.	Dip of the Horizon.	Height of the Eye in Feet.	Dip of the Horizon.
1	0 59	38	6 4
2	1 24	41	6 18
3	1 42	44	6 32
4	1 58	47	6 45
5	2 12	50	6 58
6	2 25	53	7 10
7	2 36	56	7 22
8	2 47	59	7 34
9	2 57	62	7 45
10	3 07	65	7 56
11	3 16	68	8 07
12	3 25	71	8 18
13	3 33	74	8 28
14	3 41	77	8 38
15	3 49	80	8 48
16	3 56	83	8 58
17	4 04	86	9 08
18	4 11	89	9 17
19	4 17	92	9 26
20	4 24	95	9 36
21	4 31	98	9 45
22	4 37	101	9 54
23	4 43	104	10 02
24	4 49	107	10 11
25	4 55	110	10 19
26	5 01	113	10 28
27	5 07	116	10 36
28	5 13	119	10 44
29	5 18	122	10 52
30	5 24	125	11 00
31	5 29	128	11 08
32	5 34	131	11 16
33	5 39	134	11 24
34	5 44	137	11 31
35	5 49	140	11 39

TABLE B.

Dip of the Sea Horizon
at different Distances from it.

Distance in Miles.	Height of the Eye in Feet.					
	5	10	15	20	25	30
1	11	22	34	45	56	68
2	6	11	17	22	28	34
3	4	8	12	15	19	23
4	4	6	9	12	15	17
5	3	5	7	9	12	14
6	3	4	6	8	10	12
7	2	3	5	6	8	10
8	2	3	5	6	7	8
9	2	3	4	5	6	7
10	2	3	4	5	6	6
11	2	3	4	4	5	6
12	2	3	4	4	5	5
13	2	3	4	4	5	5
14	2	3	4	4	5	5
15	2	3	4	4	5	5
16	2	3	4	4	5	5
17	2	3	4	4	5	5
18	2	3	4	4	5	5
19	2	3	4	4	5	5
20	2	3	4	4	5	5
21	2	3	4	4	5	5
22	2	3	4	4	5	5
23	2	3	4	4	5	5
24	2	3	4	4	5	5
25	2	3	4	4	5	5
26	2	3	4	4	5	5
27	2	3	4	4	5	5
28	2	3	4	4	5	5
29	2	3	4	4	5	5
30	2	3	4	4	5	5

TABLE VI.

Sun's
Parallax
in
Altitude.

Altitude.	Parallax.
0	9
12	9
13	8
31	8
32	7
40	7
41	6
49	6
50	5
59	5
60	4
67	4
68	3
73	3
74	2
80	2
81	1
85	1
90	0

TABLE VII.
CORRECTIONS OF THE APPARENT ALTITUDES OF THE SUN AND
STARS.

App. Alt.	Sun's Corr.	Star's Corr.	Diff. to 1'	App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.
0 0	34 45	34 54	12.5	6 1	8 13	8 22	7 1	7 10	7 19	8 32	5 58	6 7
10	32 40	32 49	11.7	2	8 12	8 21	2	7 9	7 18	34	5 56	6 5
20	30 43	30 52	10.9	3	8 10	8 19	3	7 8	7 17	36	5 55	6 4
30	28 54	29 3	10.1	4	8 9	8 18	4	7 7	7 16	38	5 54	6 3
40	27 14	27 23	9.3	5	8 8	8 17	5	7 6	7 15	40	5 53	6 2
0 50	25 41	25 50	8.5	6 6	8 7	8 16	7 6	7 5	7 14	8 42	5 51	6 0
1 0	24 16	24 25	7.8	7	8 6	8 15	7	7 4	7 13	44	5 50	5 59
10	22 58	23 7	7.1	8	8 5	8 14	8	7 3	7 12	46	5 48	5 57
20	21 47	21 56	6.5	9	8 4	8 13	9	7 2	7 11	48	5 47	5 56
30	20 42	20 51	5.9	10	8 3	8 12	10	7 1	7 10	50	5 46	5 55
1 40	19 43	19 52	5.4	6 11	8 2	8 11	7 11	7 0	7 9	8 52	5 45	5 54
1 50	18 49	18 58	4.9	12	8 1	8 10	12	6 59	7 8	54	5 43	5 52
2 0	18 0	18 9	4.6	13	8 0	8 9	13	6 58	7 7	56	5 42	5 51
10	17 14	17 23	4.2	14	7 59	8 8	14	6 58	7 7	58	5 41	5 50
15	16 53	17 2	4.2	15	7 57	8 6	15	6 57	7 6	60	5 40	5 49
2 20	16 32	16 41	4.0	6 16	7 56	8 5	7 16	6 56	7 5	9 2	5 38	5 47
25	16 12	16 21	4.0	17	7 55	8 4	17	6 55	7 4	4	5 37	5 46
30	15 52	16 1	3.8	18	7 54	8 3	18	6 55	7 4	6	5 36	5 45
35	15 33	15 42	3.8	19	7 53	8 2	19	6 54	7 3	8	5 35	5 44
40	15 14	15 23	3.6	20	7 51	8 0	20	6 53	7 2	10	5 34	5 43
2 45	14 56	15 5	3.4	6 21	7 50	7 59	7 21	6 52	7 1	9 12	5 33	5 42
50	14 39	14 48	3.4	22	7 49	7 58	22	6 52	7 1	14	5 32	5 41
2 55	14 22	14 31	3.2	23	7 48	7 57	23	6 51	7 0	16	5 31	5 40
3 0	14 6	14 15	3.2	24	7 47	7 56	24	6 50	6 59	18	5 30	5 39
5	13 50	13 59	3.0	25	7 46	7 55	25	6 49	6 58	20	5 29	5 38
3 10	13 35	13 44	3.0	6 26	7 44	7 53	7 26	6 48	6 57	9 22	5 27	5 36
15	13 20	13 29	2.8	27	7 43	7 52	27	6 47	6 56	24	5 26	5 35
20	13 6	13 15	2.8	28	7 42	7 51	28	6 46	6 55	26	5 25	5 34
25	12 52	13 1	2.6	29	7 41	7 50	29	6 45	6 54	28	5 24	5 33
30	12 39	12 48	2.4	30	7 40	7 49	30	6 44	6 53	30	5 23	5 32
3 35	12 27	12 36	2.4	6 31	7 39	7 48	7 32	6 42	6 51	9 32	5 22	5 31
40	12 15	12 24	2.4	32	7 38	7 47	34	6 41	6 50	34	5 21	5 30
45	12 3	12 12	2.4	33	7 37	7 46	36	6 39	6 48	36	5 20	5 29
50	11 52	12 1	2.2	34	7 36	7 45	38	6 38	6 47	38	5 19	5 28
55	11 41	11 50	2.2	35	7 35	7 44	40	6 36	6 45	40	5 18	5 27
4 0	11 30	11 39	2.2	6 36	7 34	7 43	7 42	6 35	6 44	9 42	5 17	5 26
5	11 20	11 29	2.0	37	7 33	7 42	44	6 34	6 43	44	5 16	5 25
10	11 9	11 18	2.0	38	7 32	7 41	46	6 32	6 41	46	5 14	5 23
15	10 59	11 8	1.8	39	7 31	7 40	48	6 30	6 39	48	5 13	5 22
20	10 50	10 59	1.8	40	7 30	7 39	50	6 28	6 37	50	5 12	5 21
4 25	10 41	10 50	2.0	6 41	7 29	7 38	7 52	6 27	6 36	9 52	5 11	5 20
30	10 31	10 40	1.8	42	7 28	7 37	54	6 25	6 34	54	5 10	5 19
35	10 22	10 31	2.0	43	7 27	7 36	56	6 24	6 33	56	5 9	5 18
40	10 12	10 21	1.8	44	7 26	7 35	58	6 22	6 31	58	5 8	5 17
45	10 3	10 12	1.8	45	7 25	7 34	60	6 20	6 29	60	5 7	5 16
4 50	9 54	10 3	1.6	6 46	7 24	7 33	8 2	6 19	6 28	10 2	5 6	5 15
4 55	9 46	9 55	1.8	47	7 23	7 32	4	6 17	6 26	4	5 5	5 14
5 0	9 37	9 46	1.6	48	7 22	7 31	6	6 16	6 25	6	5 4	5 13
5	9 29	9 38	1.4	49	7 21	7 30	8	6 14	6 23	8	5 3	5 12
10	9 22	9 31	1.4	50	7 20	7 29	10	6 13	6 22	10	5 2	5 11
5 15	9 15	9 24	1.6	6 51	7 19	7 28	8 12	6 11	6 20	10 12	5 1	5 10
20	9 7	9 16	1.4	52	7 18	7 27	14	6 10	6 19	14	5 0	5 9
25	9 0	9 9	1.4	53	7 17	7 26	16	6 8	6 17	16	4 59	5 8
30	8 53	9 2	1.4	54	7 16	7 25	18	6 7	6 16	18	4 58	5 7
35	8 46	8 55	1.4	55	7 15	7 24	20	6 6	6 15	20	4 57	5 6
5 40	8 39	8 48	1.2	6 56	7 14	7 23	8 22	6 4	6 13	10 22	4 56	5 5
45	8 33	8 42	1.2	57	7 13	7 22	24	6 3	6 12	24	4 55	5 4
50	8 27	8 36	1.2	58	7 12	7 21	26	6 2	6 11	26	4 54	5 3
5 55	8 21	8 30	1.2	6 59	7 11	7 20	28	6 1	6 10	28	4 53	5 2
6 0	8 14	8 23	1.4	7 0	7 11	7 20	30	6 0	6 9	30	4 53	5 2

TABLE VII.

CORRECTIONS OF THE APPARENT ALTITUDES OF THE SUN AND STARS.

App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.
10 32	4 52	5 1	12 32	4 5	4 14	14 30	3 31	3 39	20 30	2 25	2 33
34	4 51	5 0	34	4 4	4 13	36	3 29	3 37	42	2 23	2 31
36	4 50	4 59	36	4 4	4 13	42	3 28	3 36	54	2 22	2 30
38	4 49	4 58	38	4 3	4 12	48	3 27	3 35	21 12	2 20	2 28
40	4 48	4 57	40	4 2	4 11	54	3 26	3 34	36	2 17	2 25
10 42	4 47	4 56	12 42	4 2	4 11	15 0	3 24	3 32	22 0	2 14	2 22
44	4 46	4 55	44	4 1	4 10	6	3 23	3 31	24	2 11	2 19
46	4 45	4 54	46	4 0	4 9	12	3 21	3 29	48	2 8	2 16
48	4 44	4 53	48	4 0	4 9	18	3 20	3 28	23 12	2 6	2 14
50	4 44	4 53	50	3 59	4 8	24	3 18	3 26	36	2 3	2 11
10 52	4 43	4 52	12 52	3 58	4 7	15 30	3 17	3 25	24 0	2 1	2 9
54	4 41	4 50	54	3 58	4 7	36	3 15	3 23	24	1 59	2 7
56	4 41	4 50	56	3 57	4 6	42	3 14	3 22	48	1 56	2 4
58	4 40	4 49	58	3 56	4 5	48	3 13	3 21	25 12	1 54	2 2
60	4 39	4 48	60	3 56	4 5	54	3 12	3 20	36	1 52	2 0
11 2	4 38	4 47	13 2	3 55	4 4	16 0	3 11	3 19	26 0	1 50	1 58
4	4 37	4 46	4	3 54	4 3	6	3 10	3 18	24	1 48	1 56
6	4 36	4 45	6	3 54	4 3	12	3 9	3 17	48	1 46	1 54
8	4 35	4 44	8	3 53	4 2	18	3 7	3 15	27 12	1 44	1 52
10	4 35	4 44	10	3 53	4 2	24	3 6	3 14	36	1 42	1 50
11 12	4 34	4 43	13 12	3 52	4 1	16 30	3 5	3 13	28 0	1 40	1 48
14	4 33	4 42	14	3 52	4 1	36	3 4	3 12	24	1 38	1 46
16	4 32	4 41	16	3 51	4 0	42	3 2	3 10	48	1 36	1 44
18	4 31	4 40	18	3 51	4 0	48	3 1	3 9	29 12	1 35	1 43
20	4 31	4 40	20	3 50	3 59	54	3 0	3 8	36	1 33	1 41
11 22	4 30	4 39	13 22	3 49	3 58	17 0	2 59	3 7	30 20	1 31	1 39
24	4 29	4 38	24	3 49	3 58	6	2 58	3 6	31 0	1 28	1 36
26	4 28	4 37	26	3 48	3 57	12	2 57	3 5	31 40	1 26	1 34
28	4 27	4 36	28	3 47	3 56	18	2 55	3 3	32 30	1 23	1 31
30	4 27	4 36	30	3 47	3 56	24	2 54	3 2	33 30	1 19	1 27
11 32	4 26	4 35	13 32	3 47	3 55	17 30	2 53	3 1	34 0	1 18	1 25
34	4 25	4 34	34	3 47	3 55	36	2 52	3 0	35 0	1 15	1 22
36	4 24	4 33	36	3 46	3 54	42	2 51	2 59	36 0	1 12	1 19
38	4 24	4 33	38	3 46	3 54	48	2 50	2 58	37 0	1 9	1 16
40	4 23	4 32	40	3 45	3 53	54	2 49	2 57	38 0	1 7	1 14
11 42	4 22	4 31	13 42	3 44	3 52	18 0	2 48	2 56	39 30	1 3	1 10
44	4 22	4 31	44	3 44	3 52	6	2 47	2 55	41 0	1 0	1 6
46	4 21	4 30	46	3 43	3 51	12	2 46	2 54	42 30	0 67	1 3
48	4 20	4 29	48	3 43	3 51	18	2 45	2 53	44 0	0 54	1 0
50	4 20	4 29	50	3 42	3 50	24	2 44	2 52	46 0	0 50	0 56
11 52	4 19	4 28	13 52	3 41	3 49	18 30	2 43	2 51	48 0	0 46	0 52
54	4 18	4 27	54	3 41	3 49	36	2 42	2 50	50 0	0 43	0 48
56	4 17	4 26	56	3 40	3 48	42	2 41	2 49	52 0	0 40	0 45
58	4 16	4 25	58	3 40	3 48	48	2 40	2 48	54 0	0 37	0 42
60	4 16	4 25	60	3 39	3 47	54	2 39	2 47	56 0	0 34	0 39
12 2	4 15	4 24	14 2	3 39	3 47	19 0	2 38	2 46	59 0	0 30	0 35
4	4 14	4 23	4	3 38	3 46	6	2 37	2 45	61 0	0 28	0 32
6	4 14	4 23	6	3 38	3 46	12	2 36	2 44	65 0	0 23	0 27
8	4 13	4 22	8	3 37	3 45	18	2 35	2 43	69 0	0 19	0 22
10	4 12	4 21	10	3 37	3 45	24	2 34	2 42	73 0	0 16	0 18
12 12	4 12	4 21	14 12	3 36	3 44	19 30	2 33	2 41	75 0	0 14	0 16
14	4 11	4 20	14	3 35	3 43	36	2 32	2 40	77 0	0 12	0 14
16	4 10	4 19	16	3 35	3 43	42	2 31	2 39	79 0	0 9	0 11
18	4 10	4 19	18	3 34	3 42	48	2 30	2 38	81 0	0 8	0 9
20	4 9	4 18	20	3 34	3 42	54	2 29	2 37	83 0	0 6	0 7
12 22	4 8	4 17	14 22	3 33	3 41	20 0	2 29	2 37	85 0	0 4	0 5
24	4 8	4 17	24	3 33	3 41	6	2 28	2 36	87 0	0 2	0 3
26	4 7	4 16	26	3 32	3 40	12	2 27	2 35	88 0	0 2	0 1
28	4 6	4 15	28	3 32	3 40	18	2 26	2 34	89 0	0 1	0 0
30	4 6	4 15	30	3 31	3 39	24	2 26	2 34	90 0	0 0	0 0

TABLE VIII.
FEBRUARY, 1860.

I.

AT APPARENT NOON.

Day of the Week.	Day of the Month.	THE SUN'S				Sidereal Time of the Semidiam. passing the Meridian.*	Equation of Time, to be added to Apparent Time.	Diff. for 1 hour
		Apparent Right Ascension.	Diff. for 1 hour.	Apparent Declination.	Diff. for 1 hour.			
		h m s	s	° ' "	"	m s	m s	s
Wed.	1	20 57 33 ⁶⁹	10 ¹⁸⁴	S. 17 13 44 ²	42 ⁷⁵	1 8 ³¹	13 49 ²⁶	0 ³²⁷
Thur.	2	21 1 38 ¹⁰	10 ¹⁴⁹	16 56 38 ²	43 ⁴⁹	1 8 ²⁰	13 57 ¹⁰	0 ²⁹¹
Frid.	3	21 5 41 ⁶⁶	10 ¹¹⁴	16 39 14 ⁶	44 ²¹	1 8 ⁰⁸	14 4 ⁰⁸	0 ²⁵⁶
Sat.	4	21 9 44 ³⁹	10 ⁰⁸⁰	16 21 33 ⁶	44 ⁹¹	1 7 ⁹⁶	14 10 ²³	0 ²²²
Sun.	5	21 13 46 ³⁰	10 ⁰⁴⁵	16 3 35 ⁸	45 ⁶⁰	1 7 ⁸⁵	14 15 ⁵⁸	0 ¹⁸⁸
Mon.	6	21 17 47 ³⁸	10 ⁰¹¹	15 45 21 ⁵	46 ²⁷	1 7 ⁷³	14 20 ⁰⁹	0 ¹⁵⁴
Tues.	7	21 21 47 ⁶⁴	9 ⁹⁷⁸	15 26 51 ¹	46 ⁹³	1 7 ⁶²	14 23 ⁷⁹	0 ¹²¹
Wed.	8	21 25 47 ¹¹	9 ⁹⁴⁵	15 8 4 ⁹	47 ⁵⁶	1 7 ⁵¹	14 26 ⁶⁹	0 ⁰⁸⁸
Thur.	9	21 29 45 ⁷⁸	9 ⁹¹²	14 49 3 ⁴	48 ¹⁸	1 7 ³⁹	14 28 ⁸⁰	0 ⁰⁵⁵
Frid.	10	21 33 43 ⁶⁷	9 ⁸⁸⁰	14 29 47 ⁰	48 ⁷⁸	1 7 ²⁸	14 30 ¹³	0 ⁰²³
Sat.	11	21 37 40 ⁷⁸	9 ⁸⁴⁸	14 10 16 ⁰	49 ³⁸	1 7 ¹⁷	14 30 ⁶⁸	0 ⁰⁰⁸
Sun.	12	21 41 37 ¹³	9 ⁸¹⁷	13 50 30 ⁸	49 ⁹⁶	1 7 ⁰⁶	14 30 ⁴⁸	0 ⁰³⁹
Mon.	13	21 45 32 ⁷³	9 ⁷⁸⁶	13 30 32 ⁰	50 ⁵¹	1 6 ⁹⁵	14 29 ⁵³	0 ⁰⁷⁰
Tues.	14	21 49 27 ⁶⁰	9 ⁷⁵⁵	13 10 19 ⁷	51 ⁰⁵	1 6 ⁸⁴	14 27 ⁸⁴	0 ¹⁰⁰
Wed.	15	21 53 21 ⁷³	9 ⁷²⁵	12 49 54 ⁶	51 ⁵⁷	1 6 ⁷⁴	14 25 ⁴²	0 ¹³⁰
Thur.	16	21 57 15 ¹⁴	9 ⁶⁹⁶	12 29 16 ⁹	52 ⁰⁷	1 6 ⁶³	14 22 ²⁹	0 ¹⁵⁹
Frid.	17	22 1 7 ⁸⁵	9 ⁶⁶⁷	12 8 27 ²	52 ⁵⁵	1 6 ⁵³	14 18 ⁴⁵	0 ¹⁸⁸
Sat.	18	22 4 59 ⁸⁶	9 ⁶³⁹	11 47 25 ⁹	53 ⁰²	1 6 ⁴³	14 13 ⁹³	0 ²¹⁷
Sun.	19	22 8 51 ¹⁹	9 ⁶¹⁰	11 26 13 ³	53 ⁴⁸	1 6 ³³	14 8 ⁷¹	0 ²⁴⁵
Mon.	20	22 12 41 ⁸⁴	9 ⁵⁸²	11 4 49 ⁹	53 ⁹¹	1 6 ²³	14 2 ⁸²	0 ²⁷³
Tues.	21	22 16 31 ⁸²	9 ⁵⁵⁵	10 43 16 ²	54 ³²	1 6 ¹³	13 56 ²⁷	0 ³⁰⁰
Wed.	22	22 20 21 ¹⁵	9 ⁵²⁸	10 21 32 ⁶	54 ⁷¹	1 6 ⁰⁴	13 49 ⁰⁶	0 ³²⁷
Thur.	23	22 24 9 ⁸⁴	9 ⁵⁰²	9 59 39 ⁵	55 ⁰⁹	1 5 ⁹⁵	13 41 ²²	0 ³⁵³
Frid.	24	22 27 57 ⁹⁰	9 ⁴⁷⁷	9 37 37 ³	55 ⁴⁵	1 5 ⁸⁶	13 32 ⁷⁴	0 ³⁷⁹
Sat.	25	22 31 45 ³⁴	9 ⁴⁵²	9 15 26 ⁶	55 ⁷⁹	1 5 ⁷⁷	13 23 ⁶⁶	0 ⁴⁰⁴
Sun.	26	22 35 32 ¹⁸	9 ⁴²⁷	8 53 7 ⁷	56 ¹¹	1 5 ⁶⁹	13 13 ⁹⁷	0 ⁴²⁸
Mon.	27	22 39 18 ⁴³	9 ⁴⁰³	8 30 41 ⁰	56 ⁴²	1 5 ⁶¹	13 3 ⁶⁹	0 ⁴⁵¹
Tues.	28	22 43 4 ¹¹	9 ³⁸⁰	8 8 7 ⁰	56 ⁷¹	1 5 ⁵³	12 52 ⁸⁶	0 ⁴⁷⁴
Wed.	29	22 46 49 ²⁴	9 ³⁵⁸	7 45 26 ⁰	56 ⁹⁸	1 5 ⁴⁵	12 41 ⁴⁶	0 ⁴⁹⁷
Thur.	30	22 50 3 ⁸³		S. 7 22 38 ⁴		1 5 ³⁸	12 29 ⁵³	

* Mean Time of the Semidiameter passing may be found by subtracting 0^m.18 from the Sidereal Time.

TABLE VIII.

II.

FEBRUARY, 1860.

AT MEAN NOON.

Day of the Week.	Day of the Month.	THE SUN'S			Equation of Time, to be subtracted from Mean Time.	Sidereal Time.
		<i>Apparent Right Ascension.</i>	<i>Apparent Declination.</i>	<i>Semidiam.*</i>		
		h m s	° ' "	" "	m s	h m s
Wed.	1	20 57 31.35	S. 17 13 54.0	16 15.9	13 49.19	20 43 42.16
Thur.	2	21 1 35.74	16 56 48.3	16 15.7	13 57.03	20 47 38.71
Frid.	3	21 5 39.29	16 39 25.0	16 15.6	14 4.02	20 51 35.27
Sat.	4	21 9 42.01	16 21 44.3	16 15.4	14 10.18	20 55 31.83
Sun.	5	21 13 43.91	16 3 46.7	16 15.2	14 15.53	20 59 28.38
Mon.	6	21 17 44.99	15 45 32.6	16 15.1	14 20.05	21 3 24.94
Tues.	7	21 21 45.25	15 27 2.3	16 14.9	14 23.76	21 7 21.49
Wed.	8	21 25 44.72	15 8 16.4	16 14.7	14 26.67	21 11 18.05
Thur.	9	21 29 43.39	14 49 15.0	16 14.6	14 28.79	21 15 14.60
Frid.	10	21 33 41.28	14 29 58.7	16 14.4	14 30.12	21 19 11.16
Sat.	11	21 37 38.40	14 10 27.9	16 14.2	14 30.68	21 23 7.72
Sun.	12	21 41 34.76	13 50 42.9	16 14.0	14 30.49	21 27 4.27
Mon.	13	21 45 30.37	13 30 44.2	16 13.8	14 29.54	21 31 0.83
Tues.	14	21 49 25.24	13 10 32.0	16 13.6	14 27.86	21 34 57.38
Wed.	15	21 53 19.39	12 50 7.0	16 13.4	14 25.45	21 38 53.94
Thur.	16	21 57 12.82	12 29 29.4	16 13.1	14 22.33	21 42 50.49
Frid.	17	22 1 5.55	12 8 39.7	16 12.9	14 18.50	21 46 47.05
Sat.	18	22 4 57.58	11 47 38.4	16 12.7	14 13.98	21 50 43.60
Sun.	19	22 8 48.92	11 26 25.9	16 12.5	14 8.76	21 54 40.16
Mon.	20	22 12 39.59	11 5 2.5	16 12.3	14 2.88	21 58 36.71
Tues.	21	22 16 29.60	10 43 28.8	16 12.0	13 56.34	22 2 33.26
Wed.	22	22 20 18.96	10 21 45.2	16 11.8	13 49.14	22 6 29.82
Thur.	23	22 24 7.67	9 59 52.1	16 11.6	13 41.30	22 10 26.37
Frid.	24	22 27 55.76	9 37 49.9	16 11.4	13 32.83	22 14 22.93
Sat.	25	22 31 43.23	9 15 39.0	16 11.2	13 23.75	22 18 19.48
Sun.	26	22 35 30.10	8 53 20.0	16 11.0	13 14.06	22 22 16.04
Mon.	27	22 39 16.38	8 30 53.3	16 10.7	13 3.79	22 26 12.59
Tues.	28	22 43 2.10	8 8 19.1	16 10.5	12 52.96	22 30 9.14
Wed.	29	22 46 47.26	7 45 38.0	16 10.3	12 41.56	22 34 5.70
Thur.	30	22 50 31.89	S. 7 22 50.3	16 10.0	12 29.64	22 38 2.25

* The Semidiameter for *Apparent* Noon may be assumed the same as that for *Mean* Noon.

TABLE VIII.

MARCH, 1865.

I.

AT APPARENT NOON.

Day of the Week.	Day of the Month.	THE SUN'S				Sidereal Time of the Semidiam. passing the Meridian.*	Equation of Time, to be added to Apparent Time.	Diff. for 1 hour
		Apparent Right Ascension.	Diff. for 1 hour.	Apparent Declination.	Diff. for 1 hour.			
		h m s	s	° ' "	"	m s	m s	s
Wed.	1	22 49 47.09	9.355	S.7 27 18.7	57.06	1 5.39	12 32.37	0.500
Thur.	2	22 53 31.35	9.334	7 4 26.1	57.31	1 5.32	12 20.11	0.531
Frid.	3	22 57 15.11	9.313	6 41 27.5	57.55	1 5.25	12 7.36	0.541
Sat.	4	23 0 58.38	9.294	6 18 23.5	57.77	1 5.18	11 54.12	0.561
Sun.	5	23 4 41.18	9.275	5 55 14.4	57.98	1 5.12	11 40.41	0.580
Mon.	6	23 8 23.55	9.257	5 32 0.5	58.17	1 5.06	11 26.26	0.598
Tues.	7	23 12 5.49	9.239	5 8 42.3	58.34	1 5.00	11 11.69	0.616
Wed.	8	23 15 47.02	9.223	4 45 20.2	58.50	1 4.94	10 56.70	0.633
Thur.	9	23 19 28.16	9.207	4 21 54.4	58.64	1 4.89	10 41.33	0.649
Frid.	10	23 23 8.95	9.192	3 58 25.4	58.77	1 4.84	10 25.60	0.663
Sat.	11	23 26 49.39	9.178	3 34 53.6	58.88	1 4.79	10 9.54	0.676
Sun.	12	23 30 29.51	9.165	3 11 19.3	58.98	1 4.75	9 53.16	0.688
Mon.	13	23 34 9.34	9.154	2 47 42.8	59.06	1 4.71	9 36.48	0.699
Tues.	14	23 37 48.90	9.144	2 24 4.5	59.13	1 4.67	9 19.54	0.710
Wed.	15	23 41 28.24	9.135	2 0 24.7	59.18	1 4.64	9 2.36	0.720
Thur.	16	23 45 7.35	9.126	1 36 43.8	59.22	1 4.60	8 44.97	0.729
Frid.	17	23 48 46.26	9.118	1 13 2.2	59.25	1 4.57	8 27.38	0.737
Sat.	18	23 52 25.00	9.111	0 49 20.1	59.26	1 4.54	8 9.61	0.743
Sun.	19	23 56 3.60	9.105	0 25 38.0	59.25	1 4.52	7 51.70	0.749
Mon.	20	23 59 42.06	9.100	S.0 1 56.3	59.23	1 4.50	7 33.67	0.754
Tues.	21	0 3 20.41	9.096	N.0 21 44.8	59.19	1 4.48	7 15.53	0.758
Wed.	22	0 6 58.68	9.093	0 45 24.9	59.14	1 4.47	6 57.30	0.761
Thur.	23	0 10 36.89	9.091	1 9 3.5	59.07	1 4.46	6 39.00	0.764
Frid.	24	0 14 15.04	9.089	1 32 40.3	58.99	1 4.45	6 20.64	0.766
Sat.	25	0 17 53.15	9.088	1 56 14.9	58.89	1 4.44	6 2.25	0.767
Sun.	26	0 21 31.24	9.087	2 19 47.0	58.78	1 4.44	5 43.85	0.767
Mon.	27	0 25 9.34	9.088	2 43 16.1	58.65	1 4.44	5 25.44	0.767
Tues.	28	0 28 47.45	9.089	3 6 41.9	58.50	1 4.44	5 7.05	0.766
Wed.	29	0 32 25.59	9.091	3 30 4.2	58.34	1 4.45	4 48.69	0.764
Thur.	30	0 36 3.78	9.093	3 53 22.3	58.16	1 4.46	4 30.37	0.762
Frid.	31	0 39 42.04	9.096	4 16 36.1	57.97	1 4.47	4 12.12	0.759
Sat.	32	0 43 20.37	9.099	N.4 39 45.2	57.77	1 4.49	3 53.96	0.755

* Mean Time of the Semidiameter passing may be found by subtracting 0^m.18 from the Sidereal Time.

TABLE VIII.
MARCH, 1865.
AT MEAN NOON.

Day of the Week.	Day of the Month.	THE SUN'S			Equation of Time, to be subtracted from Mean Time.	Sidereal Time.
		Apparent Right Ascension.	Apparent Declination.	Semidiam.*		
		h m s	° ' "	' "	m s	h m s
Wed.	1	22 49 45 ¹³	S. 7 27 30 ⁶	16 10 ¹	12 32 ⁴⁷	22 37 12 ⁶⁶
Thur.	2	22 53 29 ⁴³	7 4 37 ⁸	16 9 ⁹	12 20 ²²	22 41 9 ²¹
Frid.	3	22 57 13 ²³	6 41 39 ¹	16 9 ⁶	12 7 ⁴⁷	22 45 5 ⁷⁶
Sat.	4	23 0 56 ⁵⁴	6 18 34 ⁹	16 9 ⁴	11 54 ²³	22 49 2 ³¹
Sun.	5	23 4 39 ³⁸	5 55 25 ⁶	16 9 ¹	11 40 ⁵²	22 52 58 ⁸⁶
Mon.	6	23 8 21 ⁷⁹	5 32 11 ⁶	16 8 ⁸	11 26 ³⁷	22 56 55 ⁴²
Tues.	7	23 12 3 ⁷⁷	5 8 53 ²	16 8 ⁵	11 11 ⁸⁰	23 0 51 ⁹⁷
Wed.	8	23 15 45 ³⁴	4 45 30 ⁹	16 8 ³	10 56 ⁸²	23 4 48 ⁵²
Thur.	9	23 19 26 ⁵²	4 22 4 ⁹	16 8 ⁰	10 41 ⁴⁵	23 8 45 ⁰⁷
Frid.	10	23 23 7 ³⁵	3 58 35 ⁷	16 7 ⁸	10 25 ⁷²	23 12 41 ⁶³
Sat.	11	23 26 47 ⁸³	3 35 3 ⁶	16 7 ⁵	10 9 ⁶⁵	23 16 38 ¹⁸
Sun.	12	23 30 28 ⁰⁰	3 11 29 ⁰	16 7 ²	9 53 ²⁷	23 20 34 ⁷³
Mon.	13	23 34 7 ⁸⁷	2 47 52 ³	16 6 ⁹	9 36 ⁵⁹	23 24 31 ²⁸
Tues.	14	23 37 47 ⁴⁸	2 24 13 ⁷	16 6 ⁷	9 19 ⁶⁵	23 28 27 ⁸³
Wed.	15	23 41 26 ⁸⁶	2 0 33 ⁶	16 6 ⁴	9 2 ⁴⁷	23 32 24 ³⁹
Thur.	16	23 45 6 ⁰²	1 36 52 ⁴	16 6 ²	8 45 ⁰⁸	23 36 20 ⁹⁴
Frid.	17	23 48 44 ⁹⁷	1 13 10 ⁵	16 5 ⁹	8 27 ⁴⁸	23 40 17 ⁴⁹
Sat.	18	23 52 23 ⁷⁵	0 49 28 ²	16 5 ⁶	8 9 ⁷¹	23 44 14 ⁰⁴
Sun.	19	23 56 2 ⁴⁰	0 25 45 ⁸	16 5 ³	7 51 ⁸⁰	23 48 10 ⁵⁹
Mon.	20	23 59 40 ⁹¹	S. 0 2 3 ⁷	16 5 ¹	7 33 ⁷⁷	23 52 7 ¹⁴
Tues.	21	0 3 19 ³¹	N. 0 21 37 ⁷	16 4 ⁸	7 15 ⁶²	23 56 3 ⁶⁹
Wed.	22	0 6 57 ⁶³	0 45 18 ⁰	16 4 ⁶	6 57 ³⁸	0 0 0 ²⁵
Thur.	23	0 10 35 ⁸⁸	1 8 56 ⁹	16 4 ³	6 39 ⁰⁸	0 3 56 ⁸⁰
Frid.	24	0 14 14 ⁰⁷	1 32 34 ⁰	16 4 ⁰	6 20 ⁷²	0 7 53 ³⁵
Sat.	25	0 17 52 ²³	1 56 8 ⁹	16 3 ⁷	6 2 ³³	0 11 49 ⁹⁰
Sun.	26	0 21 30 ³⁷	2 19 41 ³	16 3 ⁵	5 43 ⁹²	0 15 46 ⁴⁵
Mon.	27	0 25 8 ⁵¹	2 43 10 ⁸	16 3 ²	5 25 ⁵¹	0 19 43 ⁰¹
Tues.	28	0 28 46 ⁶⁷	3 6 37 ⁰	16 2 ⁹	5 7 ¹¹	0 23 39 ⁵⁶
Wed.	29	0 32 24 ⁸⁶	3 29 59 ⁵	16 2 ⁶	4 48 ⁷⁵	0 27 36 ¹¹
Thur.	30	0 36 3 ¹⁰	3 53 17 ⁹	16 2 ³	4 30 ⁴³	0 31 32 ⁶⁷
Frid.	31	0 39 41 ⁴⁰	4 16 32 ⁰	16 2 ⁰	4 12 ¹⁸	0 35 29 ²²
Sat.	32	0 43 19 ⁷⁸	N. 4 39 41 ⁴	16 1 ⁷	3 54 ⁰¹	0 39 25 ⁷⁷

* The Semidiameter for *Apparent* Noon may be assumed the same as that for *Mean* Noon.

TABLE VIII.

APRIL, 1866.

I.

AT APPARENT NOON.

Day of the Week.	Day of the Month.	THE SUN'S				Sidereal Time of the Semidiam. passing the Meridian.*	Equation of Time, to be added to sub. from Apparent Time.	Diff. for 1 hour
		Apparent Right Ascension.	Diff. for 1 hour.	Apparent Declination.	Diff. for 1 hour.			
		h m s	s	° ' "	"	m s	m s	s
Sun.	1	0 42 26.29	9.093	N.4 34 2.2	57.80	1 4.49	3 57.51	0.762
Mon.	2	0 46 4.58	9.098	4 57 6.8	57.58	1 4.51	3 39.29	0.756
Tues.	3	0 49 43.00	9.104	5 20 6.2	57.36	1 4.53	3 21.21	0.750
Wed.	4	0 53 21.58	9.112	5 43 0.2	57.13	1 4.55	3 3.29	0.743
Thur.	5	0 57 0.35	9.120	6 5 48.3	56.88	1 4.58	2 45.56	0.735
Frid.	6	1 0 39.32	9.128	6 28 30.1	56.61	1 4.61	2 28.01	0.727
Sat.	7	1 4 18.50	9.137	6 51 5.4	56.33	1 4.64	2 10.68	0.717
Sun.	8	1 7 57.91	9.147	7 13 33.7	56.03	1 4.67	1 53.60	0.706
Mon.	9	1 11 37.58	9.159	7 35 54.8	55.72	1 4.71	1 36.77	0.695
Tues.	10	1 15 17.53	9.171	7 58 8.3	55.40	1 4.74	1 20.21	0.684
Wed.	11	1 18 57.77	9.183	8 20 13.9	55.06	1 4.78	1 3.94	0.672
Thur.	12	1 22 38.31	9.196	8 42 11.1	54.71	1 4.83	0 47.97	0.659
Frid.	13	1 26 19.17	9.209	9 3 59.8	54.34	1 4.88	0 32.32	0.645
Sat.	14	1 30 0.36	9.223	9 25 39.5	53.96	1 4.92	0 17.01	0.631
Sun.	15	1 33 41.90	9.238	9 47 9.8	53.56	1 4.97	0 2.03	0.617
Mon.	16	1 37 23.79	9.253	10 8 30.4	53.15	1 5.02	0 12.60	0.602
Tues.	17	1 41 6.04	9.268	10 29 41.0	52.73	1 5.08	0 26.85	0.586
Wed.	18	1 44 48.67	9.284	10 50 41.3	52.29	1 5.14	0 40.73	0.570
Thur.	19	1 48 31.69	9.300	11 11 30.8	51.83	1 5.20	0 54.23	0.554
Frid.	20	1 52 15.10	9.317	11 32 9.2	51.36	1 5.26	1 7.34	0.538
Sat.	21	1 55 58.92	9.334	11 52 36.3	50.88	1 5.33	1 20.04	0.521
Sun.	22	1 59 43.15	9.352	12 12 51.6	50.39	1 5.39	1 32.33	0.503
Mon.	23	2 3 27.81	9.370	12 32 54.8	49.88	1 5.46	1 44.19	0.485
Tues.	24	2 7 12.92	9.389	12 52 45.5	49.35	1 5.53	1 55.60	0.466
Wed.	25	2 10 58.48	9.408	13 12 23.5	48.81	1 5.60	2 6.56	0.447
Thur.	26	2 14 44.51	9.428	13 31 48.5	48.26	1 5.67	2 17.06	0.427
Frid.	27	2 18 31.03	9.449	13 51 0.1	47.70	1 5.74	2 27.06	0.407
Sat.	28	2 22 18.05	9.470	14 9 58.1	47.13	1 5.81	2 36.57	0.386
Sun.	29	2 26 5.57	9.491	14 28 42.2	46.54	1 5.89	2 45.58	0.364
Mon.	30	2 29 53.63	9.514	14 47 12.0	45.94	1 5.97	2 54.05	0.342
Tues.	31	2 33 42.23	9.536	N.15 5 27.1	45.32	1 6.05	3 1.98	0.319

* Mean Time of the Semidiameter passing may be found by subtracting 0^s.18 from the Sidereal Time.

TABLE VIII.

H.

APRIL, 1866.

AT MEAN NOON.

Day of the Week.	Day of the Month.	THE SUN'S			Equation of Time, to be subd. from added to Mean Time.	Sidereal Time.
		Apparent Right Ascension.	Apparent Declination.	Semidiam.*		
		h m s	° ' "	' "	m s	h m s
Sun.	1	0 42 25.69	N. 4 33 58.4	16 1.8	3 57.56	0 38 28.13
Mon.	2	0 46 4.02	4 57 3.3	16 1.5	3 39.33	0 42 24.69
Tues.	3	0 49 42.49	5 20 3.0	16 1.3	3 21.25	0 46 21.24
Wed.	4	0 53 21.12	5 42 57.3	16 1.0	3 3.33	0 50 17.79
Thur.	5	0 56 59.93	6 5 45.7	16 0.7	2 45.59	0 54 14.34
Frid.	6	1 0 38.94	6 28 27.8	16 0.5	2 28.04	0 58 10.89
Sat.	7	1 4 18.16	6 51 3.3	16 0.2	2 10.71	1 2 7.44
Sun.	8	1 7 57.62	7 13 31.9	15 59.9	1 53.62	1 6 4.00
Mon.	9	1 11 37.34	7 35 53.3	15 59.6	1 36.79	1 10 0.55
Tues.	10	1 15 17.33	7 58 7.1	15 59.3	1 20.23	1 13 57.10
Wed.	11	1 18 57.61	8 20 12.9	15 59.1	1 3.95	1 17 53.66
Thur.	12	1 22 38.19	8 42 10.4	15 58.8	0 47.98	1 21 50.21
Frid.	13	1 26 19.09	9 3 59.3	15 58.5	0 32.33	1 25 46.76
Sat.	14	1 30 0.32	9 25 39.2	15 58.2	0 17.01	1 29 43.31
Sun.	15	1 33 41.89	9 47 9.8	15 58.0	0 2.03	1 33 39.86
Mon.	16	1 37 23.82	10 8 30.6	15 57.7	0 12.60	1 37 36.41
Tues.	17	1 41 6.11	10 29 41.4	15 57.5	0 26.86	1 41 32.97
Wed.	18	1 44 48.78	10 50 41.9	15 57.2	0 40.74	1 45 29.52
Thur.	19	1 48 31.83	11 11 31.6	15 56.9	0 54.24	1 49 26.07
Frid.	20	1 52 15.28	11 32 10.2	15 56.7	1 7.35	1 53 22.63
Sat.	21	1 55 59.13	11 52 37.4	15 56.4	1 20.05	1 57 19.18
Sun.	22	1 59 43.39	12 12 52.8	15 56.2	1 32.34	2 1 15.73
Mon.	23	2 3 28.08	12 32 56.2	15 55.9	1 44.20	2 5 12.29
Tues.	24	2 7 13.22	12 52 47.1	15 55.7	1 55.62	2 9 8.84
Wed.	25	2 10 58.81	13 12 25.2	15 55.4	2 6.58	2 13 5.39
Thur.	26	2 14 44.87	13 31 50.3	15 55.2	2 17.08	2 17 1.95
Frid.	27	2 18 31.42	13 51 2.1	15 54.9	2 27.08	2 20 58.50
Sat.	28	2 22 18.46	14 10 0.2	15 54.7	2 36.59	2 24 55.05
Sun.	29	2 26 6.01	14 28 44.3	15 54.4	2 45.60	2 28 51.61
Mon.	30	2 29 54.09	14 47 14.2	15 54.2	2 54.07	2 32 48.16
Tues.	31	2 33 42.71	N. 15 5 29.4	15 54.0	3 2.00	2 36 44.71

* The Semidiameter for *Apparent* Noon may be assumed the same as that for *Mean* Noon.

TABLE VIII.

JUNE, 1868.

I.

AT APPARENT NOON.

Day of the Week.	Day of the Month.	THE SUN'S				Sidereal Time of the Semidiam. passing the Meridian.*	Equation of Time, to be subd. from added to Apparent Time.	Diff. for 1 hour
		Apparent Right Ascension.	Diff. for 1 hour.	Apparent Declination.	Diff. for 1 hour.			
		h m s	s	° ' "	"	m s	m s	s
Mon.	1	4 38 34.79	10.235	N.22 8 6.2	19.87	1 8.43	2 24.03	0.377
Tues.	2	4 42 40.62	10.251	22 15 51.8	18.91	1 8.48	2 14.78	0.393
Wed.	3	4 46 46.83	10.266	22 23 14.1	17.94	1 8.53	2 5.15	0.409
Thur.	4	4 50 53.39	10.280	22 30 12.9	16.96	1 8.58	1 55.17	0.423
Frid.	5	4 55 0.28	10.294	22 36 48.0	15.97	1 8.63	1 44.86	0.436
Sat.	6	4 59 7.50	10.308	22 42 59.4	14.98	1 8.67	1 34.23	0.450
Sun.	7	5 3 15.04	10.320	22 48 47.0	13.98	1 8.71	1 23.28	0.463
Mon.	8	5 7 22.87	10.332	22 54 10.6	12.98	1 8.75	1 12.03	0.474
Tues.	9	5 11 30.96	10.342	22 59 10.1	11.97	1 8.79	1 0.52	0.485
Wed.	10	5 15 39.30	10.352	23 3 45.3	10.96	1 8.82	0 48.77	0.495
Thur.	11	5 19 47.88	10.362	23 7 56.3	9.95	1 8.85	0 36.78	0.504
Frid.	12	5 23 56.68	10.371	23 11 42.8	8.93	1 8.87	0 24.58	0.513
Sat.	13	5 28 5.67	10.378	23 15 4.9	7.91	1 8.89	0 12.18	0.520
Sun.	14	5 32 14.84	10.385	23 18 2.4	6.88	1 8.91	0 0.39	0.527
Mon.	15	5 36 24.15	10.391	23 20 35.2	5.85	1 8.93	0 13.11	0.533
Tues.	16	5 40 33.59	10.395	23 22 43.4	4.83	1 8.94	0 25.95	0.537
Wed.	17	5 44 43.13	10.399	23 24 26.9	3.80	1 8.95	0 38.90	0.541
Thur.	18	5 48 52.75	10.402	23 25 45.6	2.76	1 8.96	0 51.94	0.544
Frid.	19	5 53 2.42	10.404	23 26 39.5	1.73	1 8.96	1 5.02	0.545
Sat.	20	5 57 12.12	10.404	23 27 8.6	0.70	1 8.96	1 18.12	0.546
Sun.	21	6 1 21.81	10.403	23 27 13.0	0.33	1 8.96	1 31.21	0.545
Mon.	22	6 5 31.45	10.400	23 26 52.6	1.37	1 8.95	1 44.27	0.543
Tues.	23	6 9 41.02	10.397	23 26 7.4	2.40	1 8.94	1 57.25	0.539
Wed.	24	6 13 50.49	10.392	23 24 57.5	3.43	1 8.93	2 10.12	0.534
Thur.	25	6 17 59.84	10.386	23 23 22.8	4.46	1 8.91	2 22.87	0.528
Frid.	26	6 22 9.03	10.379	23 21 23.4	5.49	1 8.89	2 35.47	0.521
Sat.	27	6 26 18.04	10.371	23 18 59.3	6.52	1 8.87	2 47.89	0.514
Sun.	28	6 30 26.85	10.363	23 16 10.7	7.54	1 8.85	3 0.12	0.505
Mon.	29	6 34 35.46	10.354	23 12 57.6	8.55	1 8.82	3 12.13	0.496
Tues.	30	6 38 43.83	10.343	23 9 20.1	9.57	1 8.79	3 23.91	0.486
Wed.	31	6 42 51.94	10.332	N.23 5 18.3	10.58	1 8.75	3 35.44	0.475

* Mean Time of the Semidiameter passing may be found by subtracting 0^m.19 from the Sidereal Time.

TABLE VIII.

II.

JUNE, 1868.

AT MEAN NOON.

Day of the Week.	Day of the Month.	THE SUN'S			Equation of Time, to be added to sub. from Mean Time.	Sidereal Time.
		Apparent Right Ascension.	Apparent Declination.	Semidiam.*		
		h m s	° ' "	' "	m s	h m s
Mon.	1	4 38 35.19	N.22 8 7.0	15 48.1	2 24.01	4 40 59.20
Tues.	2	4 42 41.00	22 15 52.5	15 47.9	2 14.76	4 44 55.76
Wed.	3	4 46 47.19	22 23 14.7	15 47.8	2 5.13	4 48 52.32
Thur.	4	4 50 53.72	22 30 13.4	15 47.7	1 55.15	4 52 48.87
Frid.	5	4 55 0.58	22 36 48.5	15 47.6	1 44.85	4 56 45.43
Sat.	6	4 59 7.77	22 42 59.8	15 47.5	1 34.22	5 0 41.99
Sun.	7	5 3 15.28	22 48 47.3	15 47.4	1 23.27	5 4 38.55
Mon.	8	5 7 23.08	22 54 10.8	15 47.3	1 12.02	5 8 35.10
Tues.	9	5 11 31.14	22 59 10.3	15 47.2	1 0.51	5 12 31.65
Wed.	10	5 15 39.45	23 3 45.5	15 47.1	0 48.76	5 16 28.21
Thur.	11	5 19 47.99	23 7 56.4	15 47.0	0 36.78	5 20 24.77
Frid.	12	5 23 56.75	23 11 42.9	15 46.9	0 24.58	5 24 21.33
Sat.	13	5 28 5.71	23 15 4.9	15 46.8	0 12.18	5 28 17.89
Sun.	14	5 32 14.84	23 18 2.4	15 46.7	0 0.39	5 32 14.45
Mon.	15	5 36 24.11	23 20 35.2	15 46.6	0 13.11	5 36 11.00
Tues.	16	5 40 33.51	23 22 43.4	15 46.5	0 25.95	5 40 7.56
Wed.	17	5 44 43.02	23 24 26.8	15 46.4	0 38.90	5 44 4.12
Thur.	18	5 48 52.60	23 25 45.5	15 46.4	0 51.93	5 48 0.67
Frid.	19	5 53 2.23	23 26 39.4	15 46.3	1 5.01	5 51 57.22
Sat.	20	5 57 11.89	23 27 8.6	15 46.2	1 18.11	5 55 53.78
Sun.	21	6 1 21.54	23 27 13.0	15 46.1	1 31.20	5 59 50.34
Mon.	22	6 5 31.15	23 26 52.6	15 46.1	1 44.25	6 3 46.90
Tues.	23	6 9 40.68	23 26 7.5	15 46.1	1 57.23	6 7 43.45
Wed.	24	6 13 50.11	23 24 57.6	15 46.1	2 10.10	6 11 40.01
Thur.	25	6 17 59.42	23 23 23.0	15 46.1	2 22.85	6 15 36.57
Frid.	26	6 22 8.57	23 21 23.6	15 46.0	2 35.45	6 19 33.12
Sat.	27	6 26 17.55	23 18 59.6	15 46.0	2 47.87	6 23 29.68
Sun.	28	6 30 26.33	23.16 11.1	15 46.0	3 0.09	6 27 26.24
Mon.	29	6 34 34.90	23 12 58.1	15 46.0	3 12.10	6 31 22.80
Tues.	30	6 38 43.24	23 9 20.7	15 46.0	3 23.88	6 35 19.36
Wed.	31	6 42 51.32	N.23 5 18.9	15 46.0	3 35.41	6 39 15.91

* The Semidiameter for *Apparent* Noon may be assumed the same as that for *Mean* Noon.

TO FIND THE SUN'S TRUE BEARING.

When it is A.M. allow 90° to the Eastward from the first Line of Bearing.
When it is P.M. allow 90° to the Westward.

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As an instance of the utility of the last Chart—

Suppose a ship be bound from Sydney to Valparaiso, then the Chart shows that by going the Composite Track no further South than 50°S , she will go 568 miles shorter distance, and will have fresh, fair winds and favourable currents, while, by the Mercator Track she will have light variable winds and variable currents.

TO KNOW WHEN TO CHANGE THE COURSE.

RULE.—Mark the Ship's position on the chart every day at noon, then find the course as before.

NOTE.—The above rule is sufficiently exact for practical navigation.

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